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This research was done to determine whether formal kindergarten training in alphabet and number names would result in a higher reading level for children at the end of grade 1. As part of an earlier research project, two classes of primarily middle-class kindergarten children received 8 weeks of training in alphabet and number names. Two control classes participated in the regular informal kindergarten program. Preliminary analyses at the beginning of grade 1 showed that the experimental group responded to the training with a higher level of number and letter recognition than the control group. The followup study involved an analysis of The Metropolitan Achievement Test subtest scores and the reading subtest scores of the Wide Range Achievement Test which were administered at the end of grade 1. Statistical analyses measured the differential impact of the experimental procedure separately for boys and girls on scores of the Draw-a-Man Test and the Gates Reading Readiness Test, administered as pretest, post-test-I, and post-test-II. The beneficial effects of kindergarten training were dissipated by the end of grade 1. The use of reading readiness tests for individual prediction of first-grade achievement was concluded to be risky. The complete project proposal and statistical data are appended. (CM)

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FINAL REPORT: THE EFFECTS OF KINDERGARTEN INSTRUCTION IN ALPHABET AND NUMBERS ON FIRST GRADE READING

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ABSTRACT

Earlier research has demonstrated that the ability to recognize letters and numbers in kindergarten is a better predictor of end-of-first-grade reading skills than either IQ or "readiness skills." Children who are able to recognize letters and numbers respond better to beginning reading instruction than children who do not possess these skills. It therefore seemed logical to postulate that, if reading letters and numbers were taught in kindergarten, this instruction would result in an increment to reading level at the end of first grade.

As part of an earlier research project, two classes of kindergarten children were given eight weeks of training in alphabet and number names. Two control classes participated in the regular informal kindergarten program. The majority of the children in both experimental and control groups were from middle-class families. Preliminary analyses at the beginning of first grade showed that the experimental group did respond to the training and that their level of recognition of numbers and letters was higher than that of the control group.

The current research involved a follow-up of the children in both the experimental and control groups to assess the effects of the special training on end-of-first-grade reading. This included testing the children with both group and individually administered reading tests. The statistical analyses were designed to measure the differential impact of the experimental procedure separately for boys and girls on scores on reading readiness tests administered in kindergarten. In addition, the analyses were designed to improve the efficiency of prediction of reading scores at the end of first grade from variables measured in kindergarten.

It was found that the beneficial effects of kindergarten training in letters and numbers were dissipated by the end of the first grade. From this information, together with the results of earlier studies, one could hypothesize that formalized training in reading readiness does not affect subsequent ability to read, but rather affects only the scores achieved on reading readiness tests following completion of the training period. Thus, special training in reading readiness may have only the effect of teaching children how to take reading readiness tests rather than teaching them skills that can be applied to new learning.

THE EFFECTS OF KINDERGARTEN INSTRUCTION IN ALPHABET AND NUMBERS ON FIRST GRADE READING

FINAL REPORT

September 27, 1968

The purpose of this research was to determine whether formal kindergarten training in alphabet and number names would result in children's reading at a higher level at the end of first grade. The research was initiated to follow up a previous study in which children in an experimental group were given eight weeks of formal training in alphabet and number names, while a control group was exposed only to the usual informal kindergarten program. The follow-up of the same children at the end of first grade was based on a group test of achievement and an individually administered test of word recognition.

The rationale behind this research was presented in considerable detail in the project proposal. Rather than repeat for this report the details of problem definition, background, purpose, related research, specific objectives, experimental procedure, instrumentation, analytic method, and timing of the study, these aspects of the proposal are reproduced in Appendix I. The statistical analyses (in addition to being a self-contained report) are also quite lengthy and are therefore presented separately in Appendix II.

The final report of this project consists of a description of the experimental procedure, and a summarization of the results and conclusions.

EXPERIMENTAL PROCEDURE

The Metropolitan Achievement Test (M.A.T.) and the Reading Subtest of the Wide Range Achievement Test (W.R.A.T.) were administered by the project staff to the 110 children comprising the experimental and control groups at the end of first grade. The Metropolitan Achievement Test was given during the week of April 15, 1968. The individually administered Wide Range Achievement Test was given during the week of May 20, 1968. The children were located in eight schools in the St. Paul area, predominantly in a middle-class area. Follow-up visits to all but one school were necessary in both cases to test those children who had been absent at the test sessions scheduled for their school.

Success in testing the children is indicated in Tables 1 and 2.

TABLE 1

Metropolitan Achievement Test

	N in Group	N Tested	% Tested
Experimental Boys	30	30	100.0
Experimental Girls	24	24	100.0
Control Boys	29	28	96.5
Control Girls	27	27	100.0

TABLE 2

Wide Range Achievement Test

	N in Group	N Tested	% Tested
Experimental Boys	30	30	100.0
Experimental Girls	24	24	100.0
Control Boys	29	29	100.0
Control Girls	27	27	100.0

Because of illness and other scheduling problems, several follow-up visits were required in certain schools. All children were located for testing with the Wide Range Achievement Test; and all but one child was located for testing with the Metropolitan Achievement Test.

The tests were scored by the project staff following administration, and the scores were made available to the schools that participated. The test scores were then transferred to punched cards in preparation for statistical analysis. (The test scores are listed in Appendix II, "Statistical Report.")

Tables 3 and 4, on the pages following, present separately for the experimental and control groups the distributional characteristics of the Metropolitan Achievement Test subtest scores and the Wide Range Achievement Test scores. It should be noted that, on the Metropolitan Achievement Test, norms for total scores are not provided by the test author. Three of the four subtests of the Metropolitan Achievement Test, however, are almost exclusively tests of reading skills and the remaining subtest is basic arithmetic knowledge. For this reason, the total score for the Metropolitan Achievement Test, listed in Tables 3 and 4, consists of the sum of the raw scores on the first three subtests only, thus presumably yielding a score in reading. The Arithmetic Subtest is treated separately.

It will be noted from Tables 3 and 4 that the cumulative distributions of scores on the Metropolitan Achievement Test and the Wide Range Achievement Test appear to be quite similar; a comparison of the medians and quartiles presented in these two tables validates this impression. The total M.A.T. score and W.R.A.T. score correlated .73 for boys and .69 for girls, suggesting that the two tests are not assessing exactly the same skills.

TABLE 3

Distributional Characteristics of Test Scores

(Experimental Group)

	Experimental Boys (N = 30)	Experimental Girls (N = 24)
Metropolitan Achievement Test		
Word Knowledge Subtest		
25th Percentile:	20	25
Median:	27	29
75th Percentile:	30	32
Range:	10-34	13-35
Word Discrimination Subtest		
25th Percentile:	22	24
Median:	26	30
75th Percentile:	31	32
Range:	10-35	11-34
Reading Subtest		
25th Percentile:	17	20
Median:	21	28
75th Percentile:	30	32
Range:	7-44	7-42
Arithmetic Subtest		
25th Percentile:	40	44
Median:	52	52
75th Percentile:	57	55
Range:	17-60	19-63
Total Score Less Arithmetic		
25th Percentile:	59	73
Median:	75	85
75th Percentile:	88	95
Range:	38-113	31-109
Wide Range Achievement Test		
25th Percentile:	34	35
Median:	40	39
75th Percentile:	45	43
Range	23-65	19-54

TABLE 4

Distributional Characteristics of Test Scores

(Control Group)

	Control Boys (N = 28)	Control Girls (N = 27)
Metropolitan Achievement Test		
Word Knowledge Subtest		
25th Percentile:	25	28
Median:	30	33
75th Percentile:	31	35
Range:	15-35	9-35
Word Discrimination Subtest		
25th Percentile:	23	28
Median:	28	31
75th Percentile:	30	32
Range:	16-35	14-35
Reading Subtest		
25th Percentile:	16	23
Median:	19	29
75th Percentile:	25	37
Range:	9-45	12-46
Arithmetic Subtest		
25th Percentile:	42	44
Median:	48	51
75th Percentile:	56	57
Range:	23-61	35-61
Total Score Less Arithmetic		
25th Percentile:	62	80
Median:	78	91
75th Percentile:	84	105
Range:	45-115	43-113
Wide Range Achievement Test		
25th Percentile:	36	37
Median:	39	41
75th Percentile:	42	46
Range:	26-56	34-62

RESULTS

All analyses were done twice, once for boys and once for girls. This has previously been demonstrated as necessary with young children by such studies as Silberberg, Iversen, and Silberberg (1968) and Silberberg and Feldt (1965).

The results are summarized below, with specific reference to the analyses specified in the contract proposal (pages 16-18, Appendix I). The proposal's specifications have been excerpted in the following discussion to eliminate the need for cross-referencing.

Specification No. 1

"1. Comparison of experimental versus control group.

"A. Group Reading Test: A two-way analysis of variance will be done to accomplish this end. The two columns will be scores for the experimental and control groups on the criterion measure (the Metropolitan Achievement Test score, excluding Arithmetic). The three rows would consist of leveling pre-test scores into equal thirds. In this way, it could be determined, if there is a difference between the experimental and control groups on end-of-first-grade reading, whether this difference occurs for children with low, average, and high readiness equally or whether this difference is due to a differential response on the part of one of these three groups. Separate analyses will be performed for boys and girls.

"B. The analyses in 1A will be repeated using the sum of scores on four of the five subtests (excluding Letters and Numbers) of the Gates Reading Readiness Test as the pre-test score.

"C. The analyses would again be repeated, except that only the Letters and Numbers Subtest of the Gates Reading Readiness Test would be used as the pre-test score."

Results (Reference: Tables 1-a, 1-b, and 1-c of Appendix II).

1.A. Pre-test level (based on all five subtests) and sex were significantly related to the group (M.A.T. less Arithmetic) reading test scores.

1.B. Pre-test level (based on the four subtests and excluding Letters and Numbers) and sex were significantly related to the group (M.A.T. less Arithmetic) reading score.

1.C. Pre-test level (based on the Letters and Numbers Subtest alone) and sex were significantly related to the group (M.A.T. less Arithmetic) reading score.

In none of the three analyses were group (experimental versus control) effects or any interaction effects found.

Conclusion

Kindergarten letters-and-numbers training had no effect on the end-of-first-grade group reading scores. However, children's pre-reading (reading readiness) skills were found to be related to subsequent reading ability. Also, girls scored higher than boys on the (M.A.T.) group test of reading ability at the end of the first grade.

Specification No. 2

"2. The same analyses as described in Number 1 above would be run again, except the individually administered Wide Range Achievement Test would be used as the criterion measure."

Results

2.A. Pre-test level (based on all five subtests) was significantly related to the individually administered (W.R.A.T.) test score.

2.B. Pre-test level (based on four subtests and excluding Letters and Numbers) was significantly related to the individually administered (W.R.A.T.) test score.

2.C. Pre-test level (based on the Letters and Numbers Subtest alone) was significantly related to the individually administered (W.R.A.T.) test score.

In none of the three analyses were group (experimental versus control) effects, sex effects, or any interaction effects found.

Conclusion

Kindergarten letters-and-numbers training had no effect on the end-of-first-grade individual reading test scores.

Specification No. 3

"3. The form of the relationship between the pre-test and both post-tests, between the two post-tests, and between the pre-test and the two criterion tests would be investigated mathematically."

Results

Pre-test versus Post-test I:

Control Group: The relationship is linear.
Experimental Group: The relationship is quadratic.

Pre-test versus Post-test II:

Control Group: The relationship is linear.
Experimental Group: The relationship is quadratic.

Post-test I versus Post-test II:

Control Group: The relationship is linear.
Experimental Group: The relationship is linear.

Pre-test versus M.A.T. (less Arithmetic):

Control Group: The relationship is linear.
Experimental Group: The relationship is linear.

Pre-test versus W.R.A.T.:

Control Group: The relationship is linear.
Experimental Group: The relationship is linear.

Comment

Linear relationships were observed in all comparisons except those between the pretest and the two post-tests for the experimental group. In the latter tests, the relationship was quadratic, indicating that letters-and-numbers training produces both immediate and lasting effects on scores on the Letters and Numbers Subtest. The linear relationships observed in the control and experimental groups in comparing the pre-test with the two tests of reading ability, however, leads to the conclusion that letters-and-numbers training in kindergarten has no effect on subsequent ability to learn to read.

Specification No.4

"4. The relationships discovered in Number 3 (above) would dictate the manner in which this part of the analysis would be done. Adjustments would be required if relationships are not linear. Transformations would be used when necessary to yield important educational data. This phase of the analysis would involve a series of step-wise regression analyses predicting to the two criterion measures.

"Predictor variables will include: the five subscale scores on the Gates Reading Readiness Test, the score on the Draw-A-Man Test (all measured in kindergarten), and the child's Chronological Age as of March 27, 1967. The following prediction equations would be obtained:

"a. Predicting to end-of-first-grade reading on the group reading test for children who have been taught the alphabet and number names in kindergarten.

"b. Predicting to end-of-first-grade reading on the group reading test for children who were not taught alphabet and number names in kindergarten.

"c. Predicting to end-of-first-grade reading on the individually administered reading tests for children who have been taught alphabet and number names in kindergarten.

"d. Predicting to end-of-first-grade reading on the individually administered reading tests for children who were not taught alphabet and number names in kindergarten.

"These equations should be useful, not only in further assessing the impact of training in alphabet and numbers in kindergarten, but also in evaluating the relative merits of the two types of reading tests (group versus individual)."

Results

Since no end-of-first-grade reading differences were found between the experimental and control groups, but were found between boys and girls, the four regression equations obtained were differentiated according to sex rather than experimental/control group.

Boys (M.A.T., N=58; W.R.A.T., N=59); Prediction Equations:

$$\text{M.A.T.} = .453\,(\text{L\&N}) + .942\,(\text{PD}) + 38.7 \qquad (R = .54)$$

$$\text{W.R.A.T.} = .194\,(\text{L\&N}) + .664\,(\text{Rhym}) + 27.9 \qquad (R = .62)$$

Girls (N = 51); Prediction Equations:

$$\text{M.A.T.} = 1.46\,(\text{PD}) + .339\,(\text{L\&N}) + 36.6 \qquad (R = .68)$$

$$\text{W.R.A.T.} = .105\,(\text{L\&N}) + .442\,(\text{DAM}) + .565\,(\text{Rhym}) + 24.7 \qquad (R = .65)$$

Key: L&N = Pre-test Letters and Numbers
PD = Pre-Test Picture Directions
Rhym = Pre-test Rhyming
DAM = Draw-A-Man

Comment

The need to predict separately for boys and girls was seen previously (Silberberg, Iversen, and Silberberg, 1968). The multiple correlations obtained in that study were of the same order of magnitude as those obtained in the present study. The predicted end-of-first-grade M.A.T. scores for girls correlated .68 with actual scores. A correlation of about the same order of magnitude, .65, was found with the W.R.A.T. serving as the test criterion. For boys, however, marked differences were observed; predicted scores for the M.A.T. correlated .54 with actual scores as opposed to .62 for the W.R.A.T. This finding, together with the previously observed sex difference on M.A.T. scores, would tend to indicate that group testing may not be as successful, at least for boys, as individual testing. In the previous study, as in the present one, the Letters and Numbers Subtest survived as a predictor of end-of-first-grade reading ability.

Specification No. 5

> "5. The Gates Reading Readiness Test consists of five subtests. Subtest Number 5, Naming Letters and Numbers, will be examined intensively in this section of the research. The total possible score on this subtest is 62, one point gained for each recognition of the 26 capital letters, one point for correct recognition of the 26 lower case letters, and ten points for correct recognition for the numbers 0 through 9. The relationship between this subtest and end-of-first-grade reading has been demonstrated previously (Silberberg, Iversen, and Silberberg, 1968). However, the experience of the project consultants has led them to hypothesize that children who know the name of one number probably know the names of many numbers, a condition which does not appear to exist in the naming of alphabet letters. Therefore, it would be valuable to examine separately the relationships between the 52 letter names and the 10 number names with the criterion variables.
>
> "The analyses described in Number 4 would be repeated, except that each of the analyses would be done twice, once using the child's raw score on naming letters alone, and the other time using the child's raw score on naming numbers alone."

Results

There was, indeed, a tendency for children to know essentially all numbers 0 through 9 on Pre-test. Forty-four of the fifty-nine boys (74.6%) knew at least eight numbers, as opposed to thirty-three of the fifty-one girls (64.7%).

Sex differences were even more striking, and in the opposite direction, when the fifty-two (upper and lower case) letters were considered. Only twenty-two of the fifty-nine boys (37.3%) knew at least sixteen letters, but thirty of the fifty-one girls (58.8%) knew at least sixteen letters.

Step-wise regressions were obtained, as specified above, but the equations are not reproduced here. The eight equations can be found in Appendix II. Of interest here is that the multiple regression coefficients for the boys' predictor equations are generally smaller than those for the girls' predictor equations. This phenomenon was observed also in the previous (Silberberg, Iversen, and Silberberg, 1968) study. It may possibly be explained on the basis of the widely held tenet that, due to earlier maturation, girls are better students than boys at the earlier stages of formal training. In addition, the present study showed that boys start out with less knowledge of (and perhaps less interest in) the alphabet than girls, and therefore pose a more difficult prediction problem.

Another explanation can be offered based on some further inspection of the data. Since Stanford Binet or WPPSI IQ's were not available for the subjects, the Draw-A-Man Test was used to approximate IQ. The girls as a group had a significantly higher mean raw score on the D.A.M. than did boys ($\bar{x} = 16.5$ for girls versus $\bar{x} = 14.7$ for boys). It was found (see tables 6-a through 6-l in Appendix II) that the sex effect was due to a significantly higher score on one subtest of the M.A.T., the Reading Subtest, which is the only criterion test in this study in which contextual cues can be used. Thus, the sex effect may well be, in truth, an IQ effect. This result is consistant with the caution expressed by some educational psychologists in the use of group tests. With most group achievement tests, it is difficult -- if not impossible -- to determine how much of a child's score is a function of his skill in the tested subject and how much is a function of his IQ.

Additional Findings

Appendix II contains a section on analyses not called for in the proposal specifications, but conducted because of their interest to this study. These cover correlation matrices, analyses of the M.A.T. subtest scores, and further analyses relating to post-testing.

Although certain experimental/control main effects and interactions were uncovered in these additional analyses, it must be pointed out that these may be the result of chance since multiple and finely detailed analyses on the same sample can be expected to turn out some "significant" findings in error. The interested reader who pursues the additional analyses of Appendix II should keep this caution in mind.

To summarize the major findings of this study, two comments would tend to suffice. First, the prediction results of a previous study (Silberberg, Iversen, and Silberberg, 1968) were confirmed. End-of-first-grade reading achievement can be predicted with as much reliability using portions, particularly the Letters and Numbers Subtest, of the Gates Reading Readiness Test as using all five subtests, although in neither case is this predictive ability of noteworthy utility. And, second, training in letters and numbers in kindergarten contributes no competitive edge to children given such training. The effects of this training are, at best, transitory and disappear by the end of the first grade.

SUMMARY AND CONCLUSIONS

Earlier research in the training of reading readiness skills has demonstrated that this training does not carry over to end-of-first-grade reading skills. However, it was also found that ability to recognize letters and numbers in kindergarten is a better predictor of end-of-first-grade reading skills than are IQ or scores on reading readiness tests. It was therefore deemed logical to postulate that the recognition of letters and numbers can be taught in kindergarten, and that the result of this instruction would be an increment in reading level at the end of first grade.

As part of an earlier research project, two classes of kindergarten children were given eight weeks of training in alphabet and number names. Two control classes participated in the regular informal kindergarten program. Scores on reading readiness tests administered at the beginning of first grade showed that the kindergarten training had a beneficial effect in that the experimental group was able to recognize numbers and letters at a higher level than could the control group.

The two groups of children, totaling 110 children, were followed up at the end of first grade. All children were administered the Wide Range Achievement Test, an individually administered test of word recognition, and the Metropolitan Achievement Test, a group test for primary grade children. It was found that the beneficial effects of the kindergarten training were dissipated by the end of first grade. It was again demonstrated that prediction of end-of-first-grade reading scores from kindergarten testing was a risky matter because of the large amount of variability which can occur over the course of that time. Even though the relationship between kindergarten and first grade tests is linear, the low multiple correlation (approximately .60) between kindergarten variables and end-of-first-grade reading obviates the use of reading readiness tests for individual prediction.

From the results of this study and those experiments leading up to it, it would appear that formalized training in reading readiness does not affect subsequent ability to read, but rather affects only the scores achieved on reading readiness tests administered immediately following completion of the training period. Quite possibly, special training in reading readiness has the effect of teaching children how to take reading readiness tests, rather than teaching them skills which can be applied to new learning.

This research was accomplished on middle class children. Given this limitation, it would appear that children who receive sufficient verbal and intellectual stimulation in their immediate environment learn more according to their physiological readiness than to this type of training. Many children have learned letter and number names spontaneously before entering kindergarten while others, despite attempts to teach them, cannot learn such information at that time.

Artificially introducing formalized instruction at an early age, therefore, does not seem to have any permanent effect; the children achieve the same level they would have been expected to achieve had they not been given any special training.

This study points out the weaknesses inherent in much of the research which underlies educational thinking in several areas. The results of cross-sectional studies can be very optimistic when attempting to evaluate new training procedures. However, longitudinal research often indicates that these benefits are transitory, if not artifacts of the training situation.

It would seem from this and earlier studies that, for middle class children, readiness training in kindergarten and, if kindergarten is perceived as a readiness experience, perhaps even kindergarten itself may be a questionable educational practice, when end-of-first-grade reading achievement is deemed the appropriate criterion of utility. One might speculate that current plans to popularize pre-kindergarten training for children (down to age 3, or even age 2) may not have potential benefits for middle class children, given the same criterion of utility.

APPENDIX I

PROJECT PROPOSAL

PROBLEM

The current popularity of pre-school programs to stimulate growth in language arts, compensatory instruction for children deficient in these areas, and enriched curricula within the kindergarten and primary grades has stimulated many research projects. Foremost among these programs has been the Head-Start Program. Although there is a considerable amount of agreement that such programs should exist despite their great expense, the question of what to include within those programs has remained a topic of debate (*Reading Teacher*, 1966). Typical questions have revolved around whether such programs should be formal or informal and, in either case, on which skills to focus. This diversity of curricula may be partly responsible for the lack of positive outcomes in many experimental studies (Jones, *et al*, 1967).

In general, pre-school and kindergarten programs emphasize readiness activities. These programs, although temporarily useful, have not served to increase school functioning. The concept of *truly* utilizing a "head start," that is, merely beginning formal training early, has *not* been rigidly examined. The proposed research is designed to assess the effects of formal kindergarten training in letter and number names on end of first grade reading skills. If the effects of accelerated learning in kindergarten survive the first year in the elementary grades, an increment will have been added to the evidence supporting head-start programs. If the advantages gained in kindergarten training "wash out" after first grade, the content of first grade programs should be examined to determine the reason for this. In addition, this should lead to examination of methods of maintaining the early advantages through the formalized program encountered in primary grades.

BACKGROUND

The teaching of readiness activities may not yield a transferrable positive outcome to the actual reading process. M. Silberberg (1966) conducted an experiment during the last eight weeks of the kindergarten year in seven representative Minneapolis, Minnesota, public schools and concluded that "The results of this study indicate that formal reading readiness training in kindergarten does not affect measured reading level at the end of first grade reading instruction." She did find, however, "that formal reading readiness training in kindergarten does affect measured reading readiness after three weeks of regular first grade readiness activities." In other words, the effect of reading readiness training seems to be to increase the children's performance on reading readiness tests, but it has no effect on their end of first grade reading scores. In a further study, utilizing the same data, step-wise regression analysis was used to predict to end of first grade reading scores, based on psychometric variables obtained in the spring of the kindergarten year, that is, before the experimental procedure had been initiated (N. Silberberg, Iversen, and M. Silberberg, 1968). A similar analysis was also done to predict to end of first grade reading scores from reading readiness tests administered at the beginning of first grade. The variables utilized as predictors included the five subtest scores on the Gates Reading Readiness Test, Stanford-Binet IQ, and Chronological Age. The results of this study indicated that ". . . the Letters and Numbers Subtest alone is nearly as efficient as all five subtest scores (of the Gates Reading Readiness Test) in predicting end-of-first-grade reading scores, and the additional information, age and IQ, contributes little if anything to increased precision in prediction. . . . This is not entirely unexpected, since the Letters and Numbers Subtest consists of the child actually reading capital letters, lower case letters, and numbers." In other words, most of the variance which could be accounted for by the prediction equations was attributable to the child's actually reading letters and numbers prior to formal reading instruction, while the other subtests, which do not involve reading per se, did not provide much additional information on how a child will actually read at the end of first grade.

PURPOSE

The obvious question to follow the results of these two earlier experiments is: Will the teaching of alphabet and numbers in kindergarten yield more transferrable skills to the actual reading process than does "readiness" (non-reading) training. To determine the answer to this question, a new project was initiated in fall, 1966, as part of a Master's thesis (Orensteen, 1968). A group of children in kindergarten was given eight weeks of formal instruction in learning alphabet and number names. Analysis of preliminary data gathered at the beginning of first grade indicates that (1) these children did learn the alphabet and numbers, when compared to a control group, and (2) there was a relationship between measured reading readiness level before the initiation of the experimental treatment and the child's reaction to the treatment. These findings were consistent with Marmon's (1966) who found that kindergarten training in reading was especially beneficial for low socio-economic children in increasing their word recognition scores at the end of kindergarten. However, the permanence of these outcomes, in terms of end of first grade reading skills, has not been evaluated. Therefore,

1. It is hypothesized that children who received instruction in alphabet and numbers in kindergarten will perform at a higher level in measured word recognition at the end of first grade than do children in a control group who receive no formal reading instruction.

2. It is further hypothesized that the children who have the lowest rate of incidental learning prior to beginning the experimental procedure will benefit most from the formalized training in alphabet and numbers.

At the present time, as a result of Orensteen's study (1968), data are available for the children in the experimental and control groups on Gates Reading Readiness Tests administered immediately before the experimental procedure, immediately after the experimental procedure, and at the beginning of first grade. It is therefore proposed that a follow-up study be done at the end of first grade to examine the above hypotheses. This would involve a re-evaluation of the readiness data, an examination of all children with an individually administered test of word recognition, and statistical analysis to establish relationships between the variables of interest.

RELATED RESEARCH

Most of the research in the area of reading readiness in general can be categorized in three areas: effects of kindergarten training versus non-kindergarten attendance, early reading studies, and reading readiness and training studies.

After reviewing the research in the first area, M. Silberberg (1966) concluded that "much of the research concerning differential functioning of kindergarten trained versus non-trained children suffers because of a variety of factors. Many of the early studies had socio-economic bias, raising the question of whether the training or the cultural level of the environment was the crucial issue. Lack of adequate control groups, small sample size, and educational and occupational level differences of the families among groups studied placed limitations on conclusions of most studies in this area."

Durkin's work (1961) has given impetus to early training of reading. She found that children with IQs ranging from 91 to 161 learned to read before attending school, but that none of these children learned without having some kind of help, either from parents or siblings. Durkin's work seems to suggest that *all* children can learn to read early. However, Silberberg and Silberberg (1967) found a group of children who seemed to have learned to read in an incidental or spontaneous way, and suggested that in some children at least reading ability was a "physiological variant."

Concerning the third category of studies, M. Silberberg (1966) found that "Most studies (of reading readiness training in kindergarten) found a negligible effect of such training on later reading skills. Again, the only groups that do have significant benefit from such training were children from bilingual homes. Conceivably, if reading readiness training could be effective, the evidence for this effectiveness may have been lost in the comparison of heterogeneous groups." (M. Silberberg, 1966, page 31.)

Recently, several doctoral dissertations have dealt with effects of reading readiness training in kindergarten. Angus (1962), Rosen (1965), Rutherford (1964), and Simpson (1960) all found that reading readiness training in kindergarten, whether it be varied or limited to certain visual-perceptual tasks, all seem to increase the tested reading readiness of the groups receiving such training when compared to the controls. Further, Angus (1962) also found that a formalized reading readiness program was superior to an incidental approach to teaching children readiness skills.

Possibly the best controlled study in this area was the one done by M. Silberberg (1966). Because of its relationship to the hypotheses stated in the proposed study, the findings of the study will be discussed in some detail. M. Silberberg summarizes her findings in this way:

> "The main purpose of this study was to measure the effect of formal reading readiness training at kindergarten level on reading readiness levels in first grade and on reading success at the end of first grade. This was accomplished by comparing an experimental group, which was given a formal reading readiness program, with a control group, which had the usual informal kindergarten program.

The experiment was conducted during the last eight weeks of the kindergarten year in seven representative Minneapolis, Minnesota, public schools. The experimental treatment was randomly assigned to either an A.M. or P.M. kindergarten class, with the alternate class taught by the same teacher constituting the control. Prior to beginning the readiness training, a standardized test of readiness level was administered as a pre-test. The experimental treatment lasted eight weeks. Supervision and direction were supplied by the experimenter.

"Post Test I, the Gates Reading Readiness Tests, was administered immediately following the experimental treatment, to determine immediate effects of the readiness training on readiness level. The Gates Reading Readiness Tests were administered again (Post Test II) at the beginning of the first grade following three weeks of readiness instruction given to all first grade children. A test of reading level, The Bond-Clymer-Hoyt Developmental Reading Test (Post Test III), was administered at the end of the first grade. Comparisons were made separately for boys and girls. The scores on the three criterion measures were compared by first, six separate analyses of variance, and then, by six separate analyses of covariance. In each analysis, the data were grouped according to levels of proficiency in one of the two pre-test measures (reading readiness and intelligence). These levels consisted of approximately the high, middle, and low third of the entire sample of children. The influence of the interrelatedness of the two pre-test measures was controlled by using one measure as the criterion of inclusion within a level and the other measure as a covariate in the six analyses of covariance. The .05 level of confidence was used for all statistical tests.

". . . The investigation was designed to answer three specific questions:

1. Does reading readiness training affect measured reading readiness immediately following formal reading readiness training in kindergarten?

"The results of this study indicate that formal reading readiness training does not affect measured reading readiness at the end of kindergarten.

2. Does reading readiness training in kindergarten affect measured reading readiness after three weeks of regular first grade readiness activities?

"The results of this study indicate that formal reading readiness training in kindergarten does affect measured reading readiness after three weeks of regular first grade readiness activities.

3. Does reading readiness training in kindergarten affect reading success as measured at the end of first grade reading instruction?

> "The results of this study indicate that formal reading readiness training in kindergarten does not affect measured reading level at the end of first grade reading instruction.
>
> "Incidental to the major findings of this study, it was found that girls, in general, exceeded boys in reading readiness and in final reading. This finding is consistent with other studies in which this factor has been considered.
>
> "These results consistently appeared in all of the analyses of variance and covariance carried out in this study, except one. It was found that, when the data were leveled by IQ utilizing the pre-test readiness scores as the covariate, there was no significant sex difference on the mean scores for Post Test I."

M. Silberberg's findings are consistent with those of other studies, and suggest that reading readiness training merely prepares students for reading readiness tests, rather than demonstrating any carry-over into the actual reading process. This observation is reinforced by the lack of any research evidence in the literature which isolates any factors in a readiness program which prepare a child for reading at a more advanced level than he would read had he not received this training. (This statement, of course, does not apply to such special situations as children from bilingual homes or other environments where verbal stimulation is artificially minimized.)

In a re-analysis of M. Silberberg's (1966) data, data from April of the kindergarten year and October of the first grade year were used to predict to end-of-first-grade reading on the Developmental Reading Tests (Silberberg, Iversen, and Silberberg, 1968). Step-wise linear regression procedures were used to predict from the Gates Reading Readiness Tests administered in April and October to the criterion variable. Stanford-Binet IQ and Chronological Age were included with the five subtests of the Gates Reading Readiness Tests as independent variables. Separate equations were obtained for boys and girls.

> "Corresponding equations were obtained for the conditions: (a) all seven independent variables being represented on the left side of the equation(even those making an inconsequential contribution to prediction), (b) only the five reading readiness subtests scores being represented, and (c) only the Letters and Numbers subtest score. These equations are of no particular interest, and they are not presented here; but the multiple correlation coefficients, which serve as measures of the reduction in the error variance associated with the estimate -- or prediction -- of end-of-first-grade reading ability are of interest and are presented in Table 1:

TABLE 1

Prediction of First Grade Reading Ability
(from Silberberg et al, 1968)

Independent Variables Represented on the Left Side of Equation	Boys		Girls	
	April testing (N=115)	October testing (N=55)	April testing (N=107)	October testing (N=59)
All seven	.59	.78	.70	.72
Only the "best" of the seven	.59	.76	.69	.70
Only the five subtest scores	.57	.78	.69	.71
Only the "best" of the five subtest scores	.56	.76	.67	.70
Only the letters & numbers subtest score	.51	.76	.58	.67

"As seen in Table 1, the Letters and Numbers subtest alone is nearly as efficient as all five subtest scores in predicting end-of-first-grade reading scores, and the additional information, age and IQ, contributes little if anything to increased precision in prediction.

"This is not entirely unexpected, since the Letters and Numbers subtest consists of the child actually reading capital letters, lower case letters, and numbers. It could be postulated that the closer a predictor variable is in context to a criterion variable, the higher the correlation. Similar results have been found for high school students (Manchester & Silberberg, 1962, pp. 131-132). For a quick test, which may be nearly as valid as the complete test, only the Letters and Numbers subtest need be administered, and probably without significant loss of information." (N. Silberberg, Iversen, and M. Silberberg, 1967.)

The importance of actually reading alphabet and numbers as predictive of later reading success has been validated in several other studies. Abbott (1963) found that "the two best predictors were the Numbers Subtest of the Metropolitan Readiness Test and the Stanford-Binet Intelligence Scale for reading achievement and the Reading Subtest and the Numbers Subtest of the Metropolitan Readiness Tests for numbers achievement." Barrett (1962) utilized multiple regression analysis and found that the Reading Letters and Numbers Subtests of the Gates Reading Readiness Tests was the best single predictor of first grade reading achievement. Barrett also found that predictive relationships were improved by increasing the similarity of the reading readiness task to the actual reading process. Kerfoot (1964) also found that the Word Matching and Naming Letters and Numbers Subtests ~~on the~~ Gates were highly correlated with first grade reading. Richardson (1963) found that children who later became outstanding readers could, even prior to kindergarten, recognize their names and could form letters of the alphabet more readily than could pupils who encountered less success in reading.

No studies were found in the literature which involved the teaching of letters and number names before first grade in an effort to improve first grade reading skills.

OBJECTIVES

1. To determine the effects of kindergarten instruction in letters and number names on reading level at the end of first grade.

2. To determine the influence of tested reading readiness level and letter recognition level before initiation of alphabet and number instruction on children's response to this instruction.

3. To contrast the emergence of the effects of the experimental instruction when children are administered a group reading test (normal procedure) versus an individually administered test of word recognition (special procedure).

4. To more accurately predict end-of-first-grade word recognition level from kindergarten information by finding "best" combinations of scores on kindergarten testing.

5. To determine the mathematical relationship between kindergarten and first grade tests.

PROCEDURE

Sample

The sample consisted of four kindergarten classes who were taught in two schools in the St. Paul, Minnesota, school district. Each kindergarten class had a different teacher. The four classes consisted of 35 experimental boys, 28 experimental girls, 32 control boys, and 30 control girls. Attrition (moving, inability to locate the child, etc.) occurred between kindergarten and the first grade and reduced the pool to a total of 111 students, consisting of 30 experimental boys, 24 experimental girls, 29 control boys, and 28 control girls.

Experimental Procedure

During the period between April 3, 1967, and May 26, 1967, the experimental group received eight weeks of special instruction. This instruction consisted of 15 minutes of formal lessons specifically concerned with teaching letter and number names. In addition, appropriate learning materials were made available so that the children within the experimental group could play with these materials during their free time. These materials were designed to reinforce the experimental instruction and, based on subjective impressions, it appeared to the teachers in the experimental **group** that the materials were very popular with the children. A copy of the lesson plan is found in Appendix A. The control teachers were not aware of the existence of an experiment but were merely informed that some special testing would take place as part of a research project. Therefore, the control teachers adhered to the regular informal St. Paul kindergarten program.

Method

Prior to the initiation of the experimental procedure, all of the subjects were administered the Gates Reading Reading Tests.* This administration of the Gates, the pre-test, was accomplished between March 27 and March 29, 1967. Immediately following the experimental procedure (June 5 and 6, 1967), another administration of the Gates Reading Readiness Test was **administered as a first** post-test. The Gates Reading Readiness Test was again administered as a second post-test between September 19 and 22, 1967, during the children's first month in first grade. In addition, each child was administered a Draw-A-Man Test between April 3 and 20, 1967. This Draw-A-Man Test was scored using the Harris (1963) technique.

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*All testing was administered and scored by Margaret C. Silberberg, Ph.D., certified school psychologist, who is a special consultant to the proposed project. The procedures for scoring the Gates Reading Readiness Test are sufficiently objective to significantly reduce the possibility of a systematic bias.

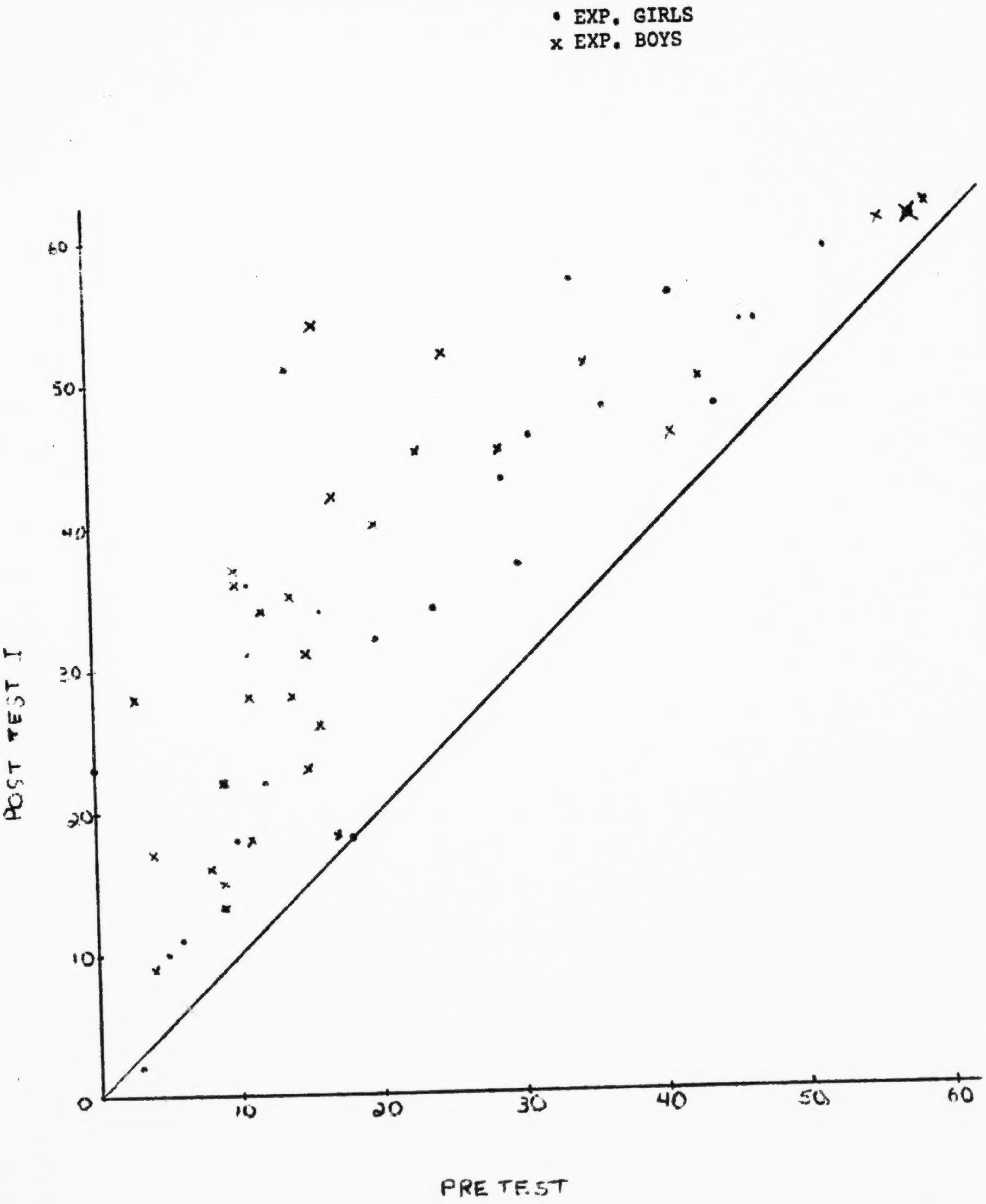

Figure 1. Relationship of scores between Pre-test and the first Post-test--Experimental Group.

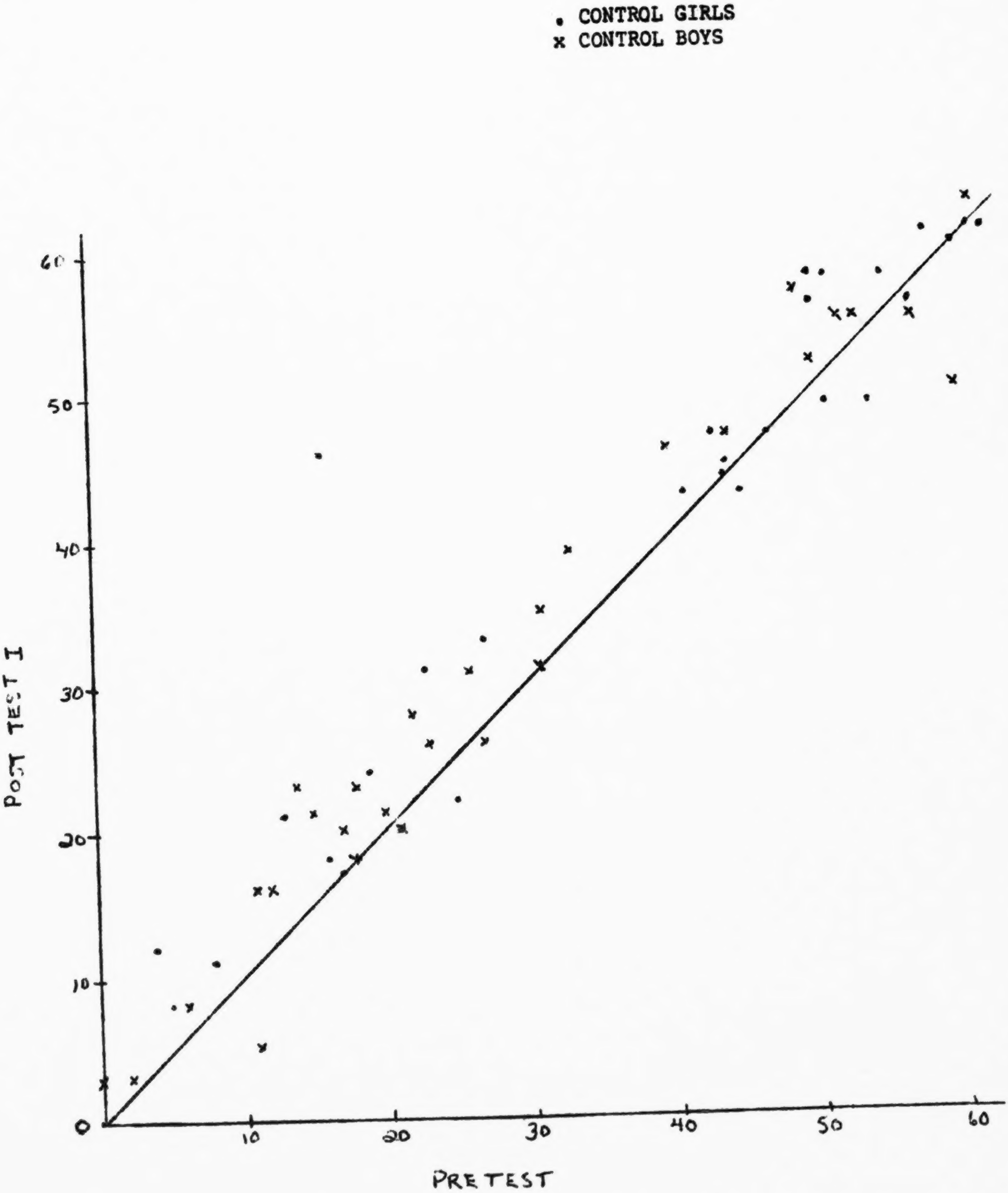

Figure 2. Relationship of scores between the Pre-test and first Post-test--Control Group.

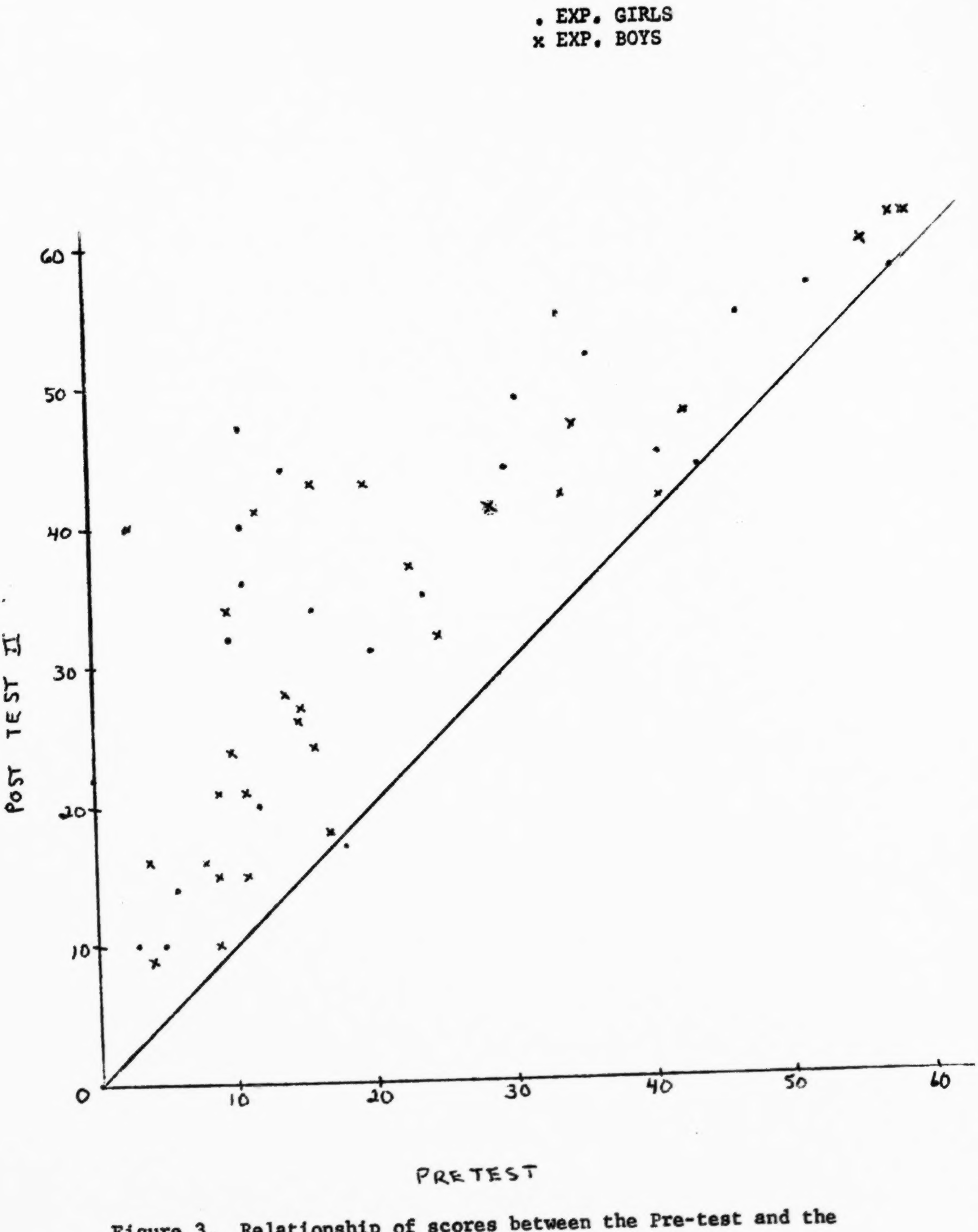

Figure 3. Relationship of scores between the Pre-test and the second Post-test--Experimental Group.

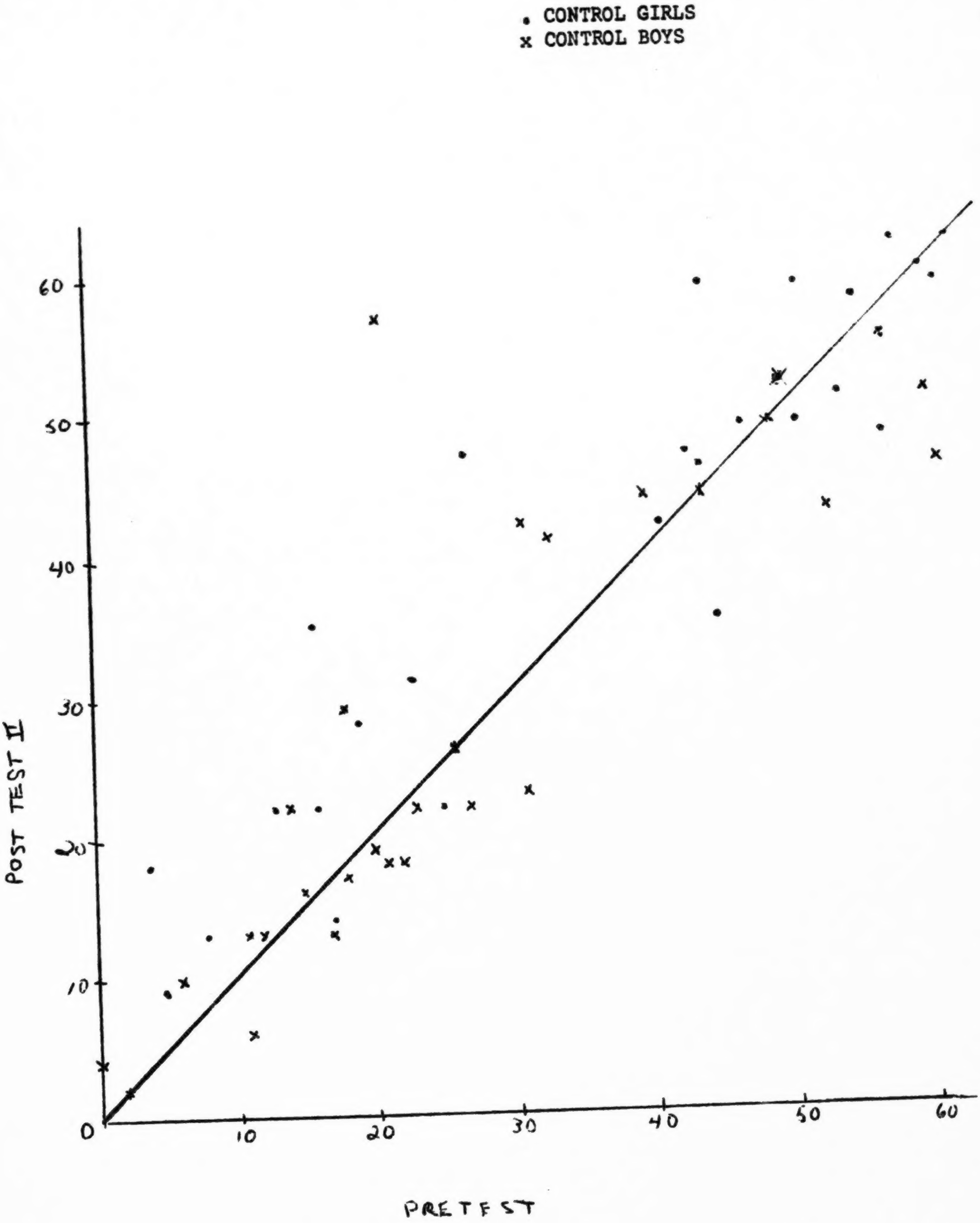

Figure 4. Relationship of scores between the Pre-test and the Second Post-test--Control Group.

Figures 1 and 2 demonstrate the relationship of each child's score on the pre-test with his score on the first post-test. Figures 3 and 4 demonstrate the relationship between the pre-test and the second post-test. It can be seen from Figures 1 and 2 that the children in the experimental group did learn the names of the alphabet letters and numbers through the experimental procedure while the control children did not learn the same information through incidental learning. Figures 3 and 4 demonstrate that this learning did not appear to be transitory but that the experimental group's superiority maintained over the three months of summer which occurred between Post-test I and Post-test II.

It is therefore proposed that the children in both the experimental and control groups be followed-up in first grade to assess the relative effects of the experimental procedure on first grade reading. This would involve the administration of two more tests: (1) the Gates Primary Reading Test would be administered to the children in April of the first grade. The purpose of this criterion measure would be to simulate as closely as possible the normal process for decision-making in the first grade. Typically, group tests are administered to children in the spring of their first grade to aid the teacher in decisions concerning retention versus non-retention as well as whether or not to place the child in special programs, if they are available. However, group reading tests at the first grade level are very susceptible to chance and the contextual cues more easily recognized by children with high IQs. For this reason, (2) the Wide Range Achievement Test (WRAT) Reading Section would be administered to all children during May of the first grade. By using a test of recognizing words in isolation and without contextual cues, the effects of training in alphabet and numbers could more validly be assessed in terms of its carry-over in the beginning reading process. The administration of the individually administered WRAT as a test of word recognition would appear to be the most efficient means of measuring this skill.

INSTRUMENTATION

1. Gates Reading Readiness Tests

See Gates, Arthur, Manual of Directions for Gates Reading Readiness Tests (N.Y.: Teachers College, 1942)

These tests were administered as a pre-test and Post-Test I and Post-Test II to assess the reading readiness level of all the children. The tests, developed following a series of investigations extending over several years, are intended for use at ending kindergarten or beginning first grade level.

The Gates Reading Readiness Tests consist of the following five subtests:

Test 1 -- Picture Directions, requests pupils to carry out verbal instructions about situations or objects in a picture. This test attempts to assess, in general, the pupil's ability to listen, understand, remember and follow verbal directions.

Test 2 -- Word Matching, requires the pupil to draw lines between similar words. It measures the child's knowledge of familiarity with printed words.

Test 3 -- Word-Card Matching, requires the pupil to match a flash card with a word in the test booklet.

Test 4 -- Rhyming, assesses the pupil's ability to recognize words which sound alike. No printed words are used in this test. The child is required to mark the picture which ends in the same sound as the word given by the examiner.

Test 5 -- Reading Letters and Numbers tests the child's familiarity with printed letters of the alphabet and numbers from 0 to 9. Letters are presented in both upper and lower cases.

The manual for the Gates Reading Readiness Tests gives the reliability coefficients, determined by computing split-halves of each test and applying the Spearman-Brown correction with a population of 174 New York City children tested during the third and fourth weeks after entering the first grade, as follows: Test 1. Picture Directions, .84; Test 2. Word Matching, .78; Test 3. Word-Card Matching, .82; Test 4. Rhyming, .84; Test 5. Letters and Numbers, .96; whole test, .974.

The correlations of the Reading Readiness Tests given at the beginning of the first grade and reading ability measured at the end of first grade by means of the Gates Primary Reading Test, Types I and II, were obtained for seven New York City public school classes. They are as follows: .89, .81, .78, .69, .57; average .706.

2. Wide Range Achievement Test

See J. S. Jastak and S. R. Jastak, Manual for the Wide Range Achievement Test (Bloomington, Delaware: Guidance Associates, 1965).

The Wide Range Achievement Test (WRAT) is an individually administered achievement test which first appeared in 1936. Despite sparse information on it, its convenience and ease of administration led to its wide use among school Psychologists. In 1965 a revised edition appeared which provided more information and certain revisions. In addition to arithmetic and spelling subtests, the WRAT assesses reading (word recognition) which is the subtest used in the project. Theoretically, word recognition is seen by some educators as the purest approach to the measurement of reading skills in that contextual cues are absent when presented in isolation rather than in sentences. The standardization of the revised test is based on a total of 5868 subjects ranging from 5 years of age to adults. No information is presented describing the adult groups, although it appears from the manual that this group consists mostly of college students and a clinic population. The test yields scores both in grade equivalents and also in standard scores corresponding to the WAIS and WISC distributions; that is, with a mean of 100 and a standard deviation of 15.

The authors report split half correlation coefficients over all age brackets ranging from .983 to .993 in the reading subtest. The authors also administered levels I and II simultaneously to those age ranges for which this was possible and correlated the results of these administrations. For the reading subtest, this was done with subjects ranging in age from 9-0 to 14-11; correlation coefficients ranged from .883 to .936. Due to the newness of the revised form, no other reliability information is yet available.

The authors present several examples of the validity of the WRAT. In one case, the reading scores of 29 fifth grade students were correlated with the teachers' ratings of their achievement on a 9-point scale, yielding a coefficient of .78. The authors also report that further evidences of validity are its sensitivity to chronological age and its agreements with the WAIS and WISC in differentiating subgroups such as culturally advantaged or disadvantaged groups. Correlations between the WRAT reading and the new Stanford Paragraph Reading and Dictation tests yielded a coefficient of .81. Seventy-four children between the ages of five and fifteen also were tested on both the WRAT and the California Maturity Tests. A correlation coefficient of .81 was obtained between the California Mental Maturity test and the WRAT reading test.

3. Gates Primary Reading Test

See Gates, Arthur, Manual for the Gates Primary Tests
(New York: Bureau of Publications, Columbia Teachers'
College, 1958)

The Primary Reading Tests is a group test which consist of three subtests -- PWR (Word-Recognition), PSR (Sentence Reading) and PR (Paragraph Reading). These three tests take 55 minutes to administer. The test yields scores in reading grade equivalent and reading ages, these norms being based on medians. The author, in a Supplement to the Manual for the Gates Reading Tests, provides information on the reliability of these subtests. The three subtests typically intercorrelate somewhere in the .80 range while the split-half reliability correlations range from .85 to .97, as reported in the Supplement to the Manual. The author also reports alternate form correlations based on several samples. For all three subtests, when testing children on the second-grade level, alternate form reliabilities typically approximate .86. The author provides little direct information on the validity of the 1958 revision of the test. The earlier revision had been subjected to many studies, and it is expected that the new addition is of acceptable validity. In fact, group tests such as this are often used as the criterion measure for assessing reading level in primary schools. Such tests typically depend on content validity which is, in these cases, the teacher's decision.

4. Draw A Man Test

See Harris, Dale, Children's Drawings as Measures of Intellectual Maturity (New York: Harcourt, Brace and World, 1963)

The Draw A Man Test has been a popular psychometric instrument since the publication of Measure of Intelligence by Drawings by Florence Goodenough in 1926. Recently, Harris has devoted a complete volume to the research and rationale surrounding this instrument and has revised the scoring scheme to conform to the improved statistical methods evolved since the test had first been in operation. In addition, Harris has established a standard score method of scaling the child's performance which corresponds to precedent set by Wechsler for the WISC. Harris reports test-retest correlations for second graders (retest occurring after a one-week time interval) ranging from .81 to .86. The research on the validity of this instrument is too extensive to approach here. Suffice to say, most of Harris' book concerns aspect of the measure's validity and 20 pages of bibliography are devoted to research studies on it. In general, the test is a relatively culture-free test which correlates well with IQ and school success. Standard score conversions are possible and these standard scores would be utilized in the input data for this research. Most generally, the instrument is seen as a test of visual motor coordination and non-verbal intelligence.

ANALYSES

All analyses described below would be done twice, once for boys and once for girls. This has been demonstrated as necessary with young children by such studies as Silberberg, Iversen, and Silberberg (1968) and Silberberg and Feldt (1965).

The following statistical analyses will be done.

1. Comparison of experimental versus control group.

A. Group Reading Test: A two-way analysis of variance will be done to accomplish this end. The two columns will be scores for the experimental and control groups on the criterion measure (the Gates Primary Reading Test score). The three rows would consist of leveling pre-test scores into equal thirds. In this way, it could be determined, if there is a difference between the experimental and control group on end-of-first-grade reading, whether this difference occurs for children with low, average, and high readiness equally or whether this difference is due to a differential response on the part of one of these **three** groups. Separate analyses will be performed for boys and girls.

B. The analyses in 1A will be repeated using the sum of scores on four of the five subtests (excluding Letters and Numbers) of the Gates Reading Readiness Test as the pre-test score.

C. The analyses would again be repeated, except that only the Letters and Numbers Subtest of the Gates Reading Readiness Test would be used as the pre-test score.

2. The same analyses as described in Number 1 above would be run again, except the individually administered Wide Range Achievement Test would be used as the criterion measure.

3. The form of the relationship between the pre-test and both post-tests, between the two post-tests, and the pre-test and the two criterion tests would be investigated mathematically.

4. The relationships discovered in Number 3 (above) would dictate the manner in which this part of the analysis would be done. Adjustments would be required if relationships are not linear. Transformations would be used when necessary to yield important educational data. This phase of the analysis would involve a series of step-wise regression analyses* predicting to the two criterion measures.

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*The mathematics of step-wise multiple regression as applied to each criterion variable can be presented briefly as follows:

Denoting y_j as the j^{th} *child's reading score and* $\hat{Y}_j = c_0 + \sum_i c_i x_{ij}$ as a linear combination of the predictor variables (the x_i's) for that child, let $\hat{y}_j = a_0 + \sum_i a_i x_{ij}$ represent the set of $\hat{Y}_j$'s for which $\sum_j (y_j - \hat{Y}_j)^2$ is a minimum. The set of $\hat{y}_j$'s then provides the best estimate in the sense of least squares of the observed y_j's.

With only seven possible predictor variables, the equation $\hat{y}_j = a_0 + \sum_j a_i x_{ij}$ would not be unnecessarily cumbersome. Building that equation one variable at a time until the incremental predictive contribution of each added variable has an approximately one-in-seven or greater probability of resulting from chance effects would, however, eliminate redundancies in the information contained in the set of independent variables.

The first variable entered as a predictor is that variable most highly correlated with the criterion variable. Additional variables are then entered (and deleted) according to the extent to which they contribute to an increasing multiple regression coefficient, subject to a pre-specified significance level.

This very sketchy discussion of step-wise regression analysis can be supplemented by any of the more recent references in mathematical or applied statistics.

Predictor variables will include: the five subscale scores on the Gates Reading Readiness Test, the score on the Draw-A-Man Test, and the child's Chronological Age (all measured in kindergarten). The following prediction equations would be obtained:

a. Predicting to end-of-first-grade reading on the group reading test for children who have been taught the alphabet and number names in kindergarten.

b. Predicting to end-of-first-grade reading on the group reading test for children who were not taught alphabet and number names in kindergarten.

c. Predicting to end-of-first-grade reading on the individually administered reading tests for children who have been taught alphabet and number names in kindergarten.

d. Predicting to end-of-first-grade reading on the individually administered reading tests for children who were not taught alphabet and number names in kindergarten.

These equations should be useful, not only in further assessing the impact of training in alphabet and numbers in kindergarten, but also in evaluating the relative merits of the two types of reading tests (group versus individual).

5. The Gates Reading Readiness Test consists of five subtests. Subtest Number 5, Naming Letters and Numbers, will be examined intensively in this section of the research. The total possible score on this subtest is 62, one point gained for each recognition of the 26 capital letters, one point for correct recognition of the 26 lower case letters, and ten points for correct recognition for the numbers 0 through 9. The relationship between this subtest and end-of-first-grade reading has been demonstrated previously (Silberberg, Iversen, and Silberberg, 1968). However, the experience of the project consultants has led them to hypothesize that children who know the name of one number probably know the names of many numbers, a condition which does not appear to exist in the naming of alphabet letters. Therefore, it would be valuable to examine separately the relationships between the 52 letter names and the 10 number names with the criterion variables.

The analyses described in number 4 would be repeated, except that each of the analyses would be done twice, once using the child's raw score on naming letters alone, and the other time using the child's raw score on naming numbers alone.

TIME SCHEDULE

1967

Already Completed

March 27 - 29	Pre-test administered (by project consultants)
April 3 - May 26	Special instruction for experimental group
April 3 - 20	Draw-A-Man Test administered (by project consultants)
June 5 - 6	First Post-test administered (by project consultants)
September 19 - 22	Second Post-test administered (by project consultants)
April 1 - November 1	Tests scored (by project consultants)
November 1 - December 1	Preliminary analyses (by project consultants)

1968

Proposed Research

April 1 - 15	Group Reading Test administered (by N. & M. Silberberg)
April 15 - 30	Group Reading Test Scored (by research assistant)
May 1 - 30	Statistical Analysis of Group Reading Test (by project directors and research assistant)
June 1 - 15	Individual Reading Tests administered (by N. & M. Silberberg)
June 15 - July 30	Statistical Analyses Completed (by project directors)
August 1 - September 30	Write reports (by project directors)

APPENDIX II

STATISTICAL APPENDIX

FINAL REPORT: THE EFFECTS OF KINDERGARTEN INSTRUCTION IN ALPHABET AND NUMBERS ON FIRST GRADE READING

STATISTICAL APPENDIX

This appendix covers in detail the analyses summarized in the Results section of the final project report. The authors felt that not all readers would have the same degree of interest in the statistical detail supporting the results of the project and that the present departure from the usual reporting format would facilitate a more readable report.

INTRODUCTION

The two experimental classes, given formal training in letters and numbers, contained 24 girls and 30 boys. The two control classes, given no such training, contained 27 girls and 29 boys. Metropolitan Achievement Test scores were not available for one boy in the control group, and in all analyses involving the M.A.T. reference is made to a sample totaling 109 rather than 110.

Supplement A of this appendix contains data listings which the reader may use to verify certain results of immediate interest or to pursue additional analyses not covered in this report. (Note that the missing M.A.T. scores for the one control boy mentioned above are represented by blanks.)

The reporting format of this statistical appendix follows closely the specifications for analyses contained in the project proposal (Appendix I).

1. ANALYSIS OF GROUP READING TEST RESULTS

This section is intended to investigate the effects of training in letters and numbers on subsequent reading achievement as measured by a group reading test. The Metropolitan Achievement Test, administered at the end of the first grade, provided the criterion for assessing reading achievement; to this end, the total of the three non-arithmetic subtest scores (reading, word knowledge, and word discrimination) is defined as the M.A.T. reading score. It is this score that is represented by the symbol "T" in the data listings contained in Supplement A. The specification for analyses, as contained in the project proposal, are as follows:

"1. Comparison of experimental versus control group.

"A. Group Reading Test: A two-way analysis of variance will be done to accomplish this end. The two columns will be scores for the experimental and control groups on the criterion measure (the Metropolitan Achievement Test score, excluding Arithmetic). The three rows would consist of leveling pre-test scores into equal thirds. In this way, it could be determined, if there is a difference between the experimental and control groups on end-of-first-grade reading, whether this difference occurs for children with low, average, and high readiness equally or whether this difference is due to a differential response on the part of one of these three groups. Separate analyses will be performed for boys and girls.

"B. The analyses in 1A will be repeated using the sum of scores on four of the five subtests (excluding Letters and Numbers) of the Gates Reading Readiness Test as the pre-test score.

"C. The analyses would again be repeated, except that only the Letters and Numbers Subtest of the Gates Reading Readiness Test would be used as the pre-test score."

1.A. Reading Readiness Pre-Test Score (Based on all Five Subtests)

Grouping the 109 children according to low, intermediate, or high scores on their Gates Reading Readiness Pre-test total scores, and separating each of the three pre-test groups into the four experimental-control/boy-girl categories, the twelve cells of Table 1-a are obtained.

The $\bar{x}$ in each cell is the mean M.A.T. end-of-first-grade reading scores for the children in that cell.

TABLE 1-a

Metropolitan Achievement Test -- End of First Grade
(Total Score Less Arithmetic)

Reading Readiness Pre-Test Score (All Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-71)	N=13 $\bar{x}$=65.6	N=11 $\bar{x}$=73.9	N=8 $\bar{x}$=64.2	N=4 $\bar{x}$=63.2
Middle (72-99)	N=11 $\bar{x}$=74.3	N=6 $\bar{x}$=88.6	N=13 $\bar{x}$=81.7	N=7 $\bar{x}$=89.7
High (100 +)	N=6 $\bar{x}$=92.3	N=7 $\bar{x}$=91.1	N=7 $\bar{x}$=84.1	N=16 $\bar{x}$=97.2

	Difference	S.E.	P
Sex Effect	6.87-	3.17	.05
Exp. Effect	.94	3.17	---
Level Effect	24.44-	3.97	.01
Sex/Exp. Interaction	.23-	3.17	---
Sex/Level Interaction	1.14	3.97	---
Exp./Level Interaction	2.46	3.97	---

(Note 1: In this table, and in those to follow, the techniques used are those usually applied in analysis of variance situations with unequal sample sizes. Sex effect, for example, was calculated as the difference between the average of the six cell means for boys and the average of the six for girls. For each comparison, or difference, the standard error of the difference is also given. The significance probability for sex effect, $P<.05$, is obtained by calculating the sex effect in units of its standard error ($-6.87/3.17 = 2.17$) and referring to tables of Student's "t" distribution. Only high-low differences were considered in calculating level effect, or any of the interactions involving level, so that readily interpretable one-degree-of-freedom comparisons could be obtained.)

(Note 2: Standard errors were presented in Table 1-a for illustrative purposes. They are not included in the remaining tables.)

As expected, reading readiness was found to be significantly related to end-of-first-grade reading achievement. Girls were also found to have achieved a reading level generally higher than that achieved by boys. There was, however, no experimental effect. Also, no interaction effects of significance were found.

Thus, given a group of boys and girls of approximately the same level of reading readiness, some of whom are given intensive training in letters and numbers and some not, one could expect the following: (1) Girls would tend to perform better than boys on subsequent group tests of reading achievement and (2) the effects of the specialized training would tend to wash out with time.

1.B. Reading Readiness Pre-Test Score (Based on the Four Subtests Excluding Letters and Numbers)

The analyses of 1.A. were repeated, with one modification. The Gates Reading Readiness Pre-test scores were recomputed with the Letters and Numbers subtest excluded, and the 109 children were grouped according to this new measure into low, intermediate, and high reading readiness levels. Table 1-b presents the equivalent of Table 1-a with this one modification.

TABLE 1-b

Metropolitan Achievement Test -- End of First Grade

(Total Score Less Arithmetic)

Reading Readiness Pre-Test Score (4 Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-55)	N=14 $\bar{x}$=64.5	N=11 $\bar{x}$=76.4	N=7 $\bar{x}$=70.0	N=6 $\bar{x}$=71.7
Middle (56-66)	N=9 $\bar{x}$=79.7	N=7 $\bar{x}$=80.1	N=14 $\bar{x}$=80.8	N=6 $\bar{x}$=96.0
High (67 +)	N=7 $\bar{x}$=86.4	N=6 $\bar{x}$=96.8	N=7 $\bar{x}$=77.7	N=15 $\bar{x}$=95.3

	Difference	P
Sex Effect	9.50-	.05
Exp. Effect	1.25-	---
Level Effect	18.42-	.01
Sex-Exp. Interaction	1.92	---
Sex-Level Interaction	3.60	---
Exp.-Level Interaction	2.73-	---

Level and sex effects are again evident and experimental and interaction effects are again absent. The conclusions of the analysis of Table 1-b are identical to those presented above for Table 1-a.

1.C. Reading Readiness Pre-Test Score (Based on Letters and Numbers Subtest Alone)

The analyses of 1.A. were again repeated, but this time only the Letters and Numbers Subtest scores were used to allocate the 109 children into the low, intermediate, and high pre-test readiness levels. Table 1-c presents the equivalent of Tables 1-a and 1-b, with this new structuring of pre-test ability.

TABLE 1-c

Metropolitan Achievement Test -- End of First Grade
(Total Score Less Arithmetic)

Reading Readiness Pre-Test Score (Letters & Numbers)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-14)	N=14 $\bar{x}=67.7$	N=10 $\bar{x}=73.6$	N=7 $\bar{x}=72.3$	N=4 $\bar{x}=75.0$
Middle (15-34)	N=10 $\bar{x}=72.3$	N=8 $\bar{x}=86.7$	N=13 $\bar{x}=75.8$	N=7 $\bar{x}=83.0$
High (35 +)	N=6 $\bar{x}=92.3$	N=6 $\bar{x}=92.2$	N=8 $\bar{x}=84.4$	N=16 $\bar{x}=97.2$

	Difference	P
Sex Effect	7.12-	.05
Exp. Effect	.45-	---
Level Effect	19.36-	.01
Sex-Exp. Interaction	.43	---
Sex-Level Interaction	1.00	---
Exp.-Level Interaction	2.22-	---

Level and sex effects are again evident and experimental and interaction effects are again absent. The conclusions of an analysis of Table 1-c are identical with those presented for Tables 1-a and 1-b.

Remarks

The three analyses presented in this section demonstrate that whether reading readiness is measured according to the total Gates Reading Readiness score, the total score including Letters and Numbers, or the Letters and Numbers Subtest score alone, the same result is obtained. End-of-first-grade reading is definitely a function of this readiness measure; girls tended to achieve a higher level of reading ability than do boys with the same degree of initial readiness; and specialized training in letters and numbers had no lasting influence on reading ability.

The criterion for assessing reading ability was the M.A.T. reading score -- a group test. In the next section, we shall see that when the criterion is an individually administered reading test, the differential reading ability between boys and girls disappears.

2. ANALYSIS OF INDIVIDUALLY ADMINISTERED READING TEST RESULTS

The purpose of this section is precisely the same as that of the preceding section, except that an individually administered reading test -- the Wide Range Achievement Test -- was used as the criterion for assessing end-of-first-grade reading achievement. The W.R.A.T. scores are listed in Supplement A, and the sample size, 110, reflects no missing data. The specifications for this section of the statistical appendix were stated in the project proposal as follows:

> "2. The same analyses as described in Number 1 above would be run again, except the individually administered Wide Range Achievement Test would be used as the criterion measure."

2.A. Reading Readiness Pre-Test Score (Based on all Five Subtests)

Grouping the 110 children exactly the same way as was done in 1.A., above, the twelve cells of Table 2-a are obtained. The $\bar{x}$'s are now, however, the mean W.R.A.T. end-of-first-grade reading scores for the children in the respective cells.

TABLE 2-a

Wide Range Achievement Test -- End of First Grade

Reading Readiness Pre-Test Score (All Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-71)	N=13 $\bar{x}$=37.0	N=11 $\bar{x}$=36.7	N=8 $\bar{x}$=35.1	N=4 $\bar{x}$=36.2
Middle (72-99)	N=11 $\bar{x}$=40.2	N=6 $\bar{x}$=42.5	N=13 $\bar{x}$=39.7	N=7 $\bar{x}$=39.7
High (100 +)	N=6 $\bar{x}$=47.7	N=7 $\bar{x}$=41.8	N=7 $\bar{x}$=45.0	N=16 $\bar{x}$=45.1

	Difference	P
Sex Effect	.41	---
Exp. Effect	.83	---
Level Effect	8.63-	.01
Sex-Exp. Interaction	.83	---
Sex-Level Interaction	1.63-	---
Exp.-Level Interaction	.74	---

Only the level effect was found to be of significance; achievement on the W.R.A.T. at the end of the first grade is an increasing function of reading readiness one year earlier. No sex, experimental, or any interaction effects of significance were found.

These results parallel closely the results obtained when reading achievement was measured using a group test, except that no sex differences were found. Where girls achieved significantly better than did boys on the group (M.A.T. reading) test, they achieved no better or worse than did boys on an individually administered (W.R.A.T.) test.

2.B. Reading Readiness Pre-Test Score (Based on the Four Subtests Excluding Letters and Numbers)

The analyses of 2.A. were repeated with the same modification as in 1.A., above. The Gates Reading Readiness Pre-Test scores were recomputed with the Letters and Numbers Subtest excluded, and the 110 children were grouped according to this new measure into low, intermediate, and high levels of reading readiness. Table 2-b presents the equivalent of Table 1-b with this one modification.

TABLE 2-b

Wide Range Achievement Test -- End of First Grade

Reading Readiness Pre-Test Score (4 Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-55)	N=14 $\bar{x}$=36.9	N=11 $\bar{x}$=37.5	N=7 $\bar{x}$=37.3	N=6 $\bar{x}$=37.2
Middle (56-66)	N=9 $\bar{x}$=42.7	N=7 $\bar{x}$=40.3	N=14 $\bar{x}$=39.3	N=6 $\bar{x}$=43.0
High (67 +)	N=7 $\bar{x}$=44.0	N=6 $\bar{x}$=42.8	N=7 $\bar{x}$=42.8	N-15 $\bar{x}$=44.3

	Difference	P
Sex Effect	.33-	---
Exp. Effect	.05	---
Level Effect	6.26-	.01
Sex-Exp. Interaction	1.30	---
Sex-Level Interaction	.06-	---
Exp.-Level Interaction	.07	---

Level effects are again evident, and sex, experimental, and interaction effects are again absent. The conclusions of the analysis of Table 2-b are identical to those presented above for Table 2-a.

2.C. Reading Readiness Pre-Test Score (Based on the Letters and Numbers Subtest Alone)

The analyses of 2.A. were again repeated, but with only the Letters and Numbers Subtest scores as a basis for allocation into the low, intermediate, and high reading readiness levels.

Table 2-c presents the equivalent of Tables 2-a and 2-b, with this new measure of readiness.

TABLE 2-c

Wide Range Achievement Test -- End of First Grade

Reading Readiness Pre-Test Score (Letters & Numbers)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-14)	N=14 $\bar{x}$=37.5	N=10 $\bar{x}$=37.1	N=7 $\bar{x}$=35.3	N=4 $\bar{x}$=37.7
Middle (15-34)	N=10 $\bar{x}$=39.8	N=8 $\bar{x}$=40.1	N=13 $\bar{x}$=38.8	N=7 $\bar{x}$=38.8
High (35 +)	N=6 $\bar{x}$=47.7	N=6 $\bar{x}$=43.3	N=8 $\bar{x}$=45.0	N=16 $\bar{x}$=45.1

	Difference	P
Sex Effect	.30	---
Exp. Effect	.77	---
Level Effect	8.37-	.01
Sex-Exp. Interaction	1.16	---
Sex-Level Interaction	1.57-	---
Exp.-Level Interaction	.17	---

Level effect is again the only effect of significance. The conclusions of an analysis of Table 2-c are identical with those presented for Table 2-a and 2-b.

Remarks

The three analyses presented in this section again demonstrate that the same result is obtained whether reading readiness is measured according to the total Gates Reading Readiness score, the total score excluding Letters and Numbers, or the Letters and Numbers Subtest alone: end-of-first-grade reading is a function of the readiness measure and specialized training in letters and numbers has no lasting effect.

The superiority of girls over boys on the group reading test, but not on the W.R.A.T., is discussed in conjunction with Table 6-n.

3. LINEAR/QUADRATIC RELATIONSHIPS

The specifications listed below call for a mathematical investigation of the relationships among the pre-test and post-test reading readiness scores and the two reading achievement tests.

> "3. The form of the relationship between the pre-test and both post-tests, between the two post-tests, and between the pre-test and the two criterion tests would be investigated mathematically."

Figures 1 and 2, on the pages following, show obvious linear relationships between the Gates Reading Readiness (total) scores and the M.A.T. reading (total less arithmetic) scores for both the experimental and control groups. Linear relationships are also evident from Figures 3 and 4, in which the Gates Reading Readiness (total) scores are compared to the W.R.A.T. scores for the experimental and control groups.

The figures displayed in the project proposal on pages 9-12 (Appendix I) show linear relationships between pre-test and post-test Letters-and-Numbers subtest scores for the control group (Figures 2

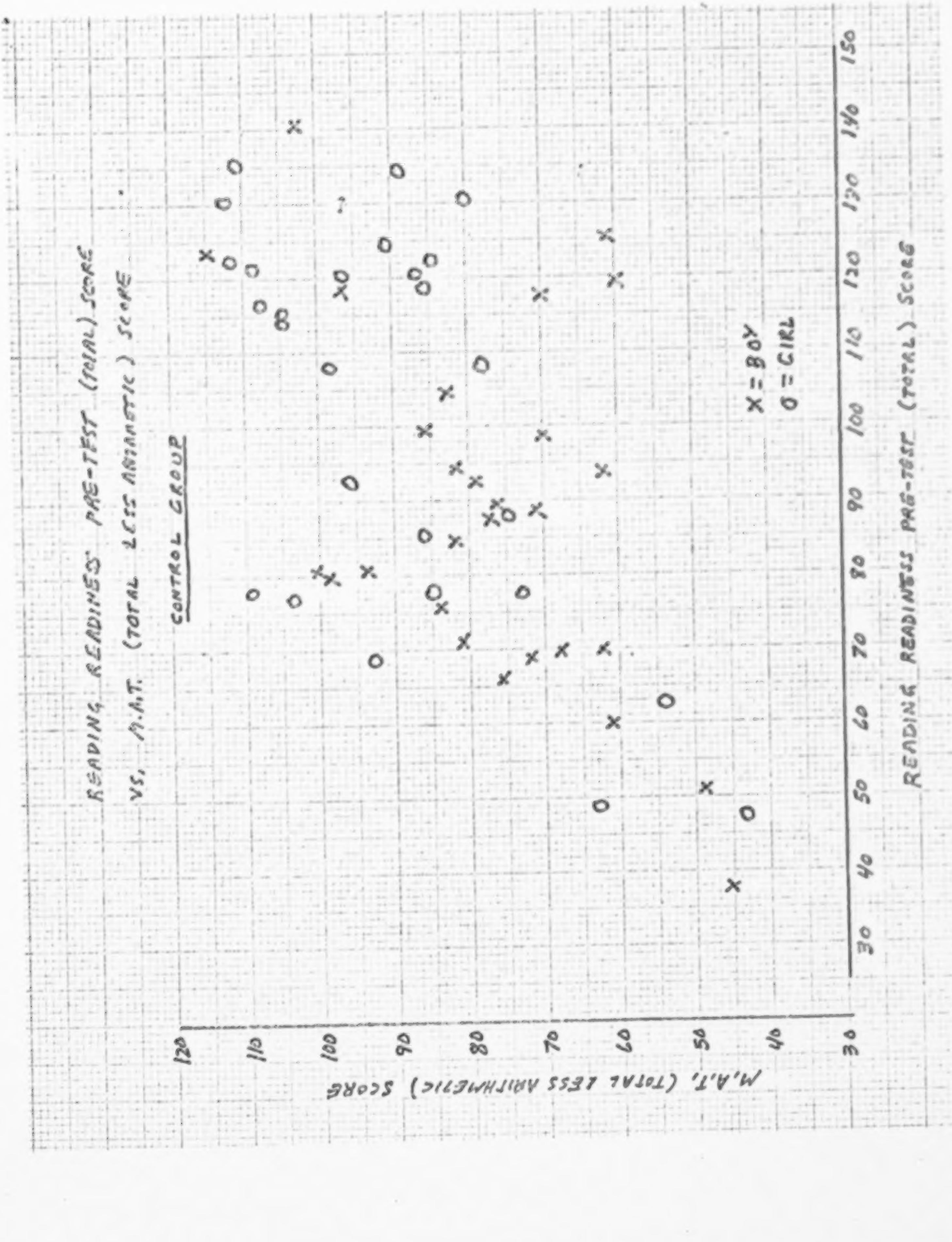
READING READINESS PRE-TEST (TOTAL) SCORE
VS. M.A.T. (TOTAL LESS ARITHMETIC) SCORE
CONTROL GROUP
X = BOY
O = GIRL
READING READINESS PRE-TEST (TOTAL) SCORE
30
40
50
60
70
80
90
100
110
120
130
140
150
M.A.T. (TOTAL LESS ARITHMETIC) SCORE
30
40
50
60
70
80
90
100
110
120

Figure 1

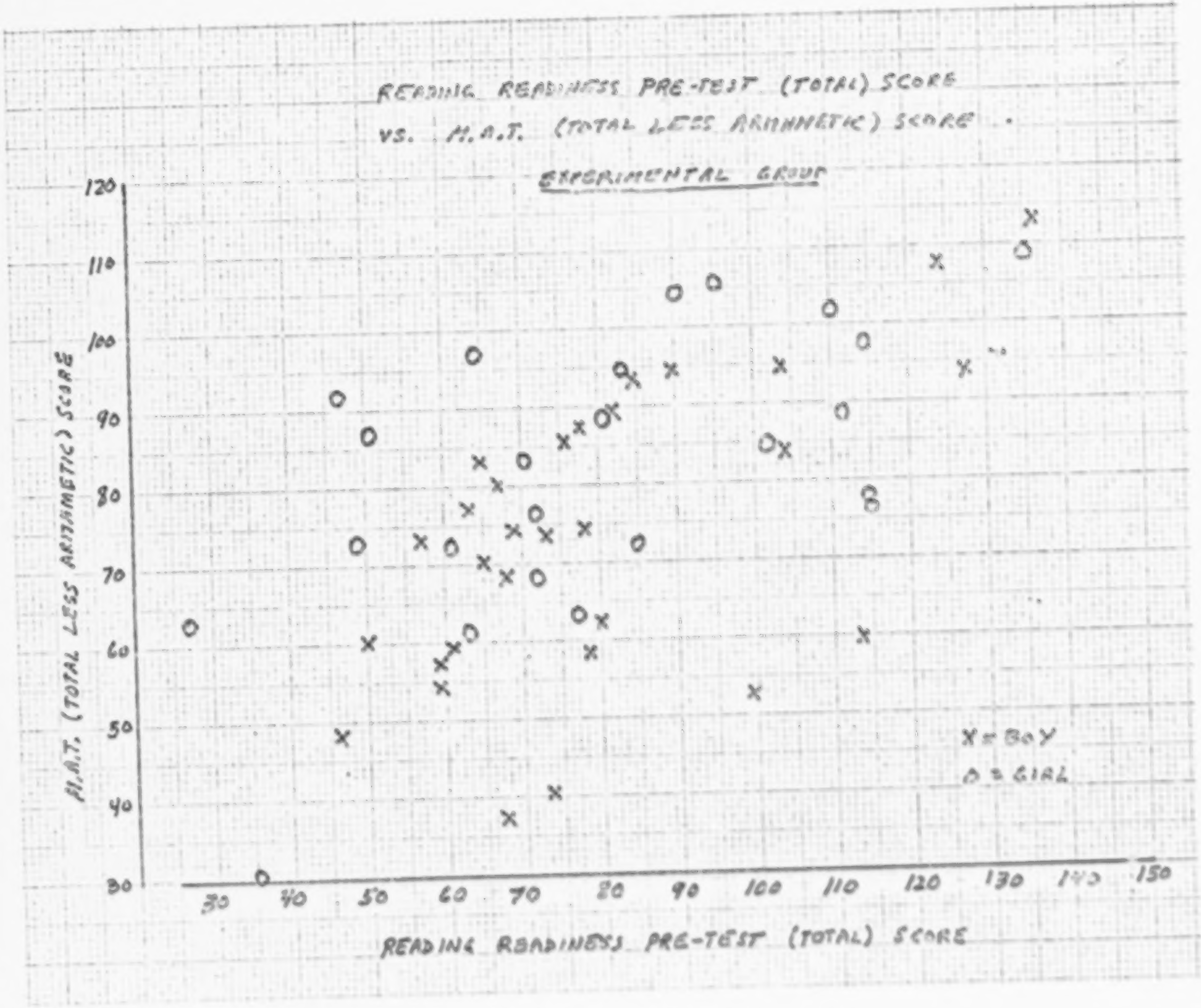
READING READINESS PRE-TEST (TOTAL) SCORE
VS. M.A.T. (TOTAL LESS ARITHMETIC) SCORE.
EXPERIMENTAL GROUP
M.A.T. (TOTAL LESS ARITHMETIC) SCORE
120
110
100
90
80
70
60
50
40
30
30
40
50
60
70
80
90
100
110
120
130
140
150
READING READINESS PRE-TEST (TOTAL) SCORE
X = BOY
O = GIRL

Figure 2

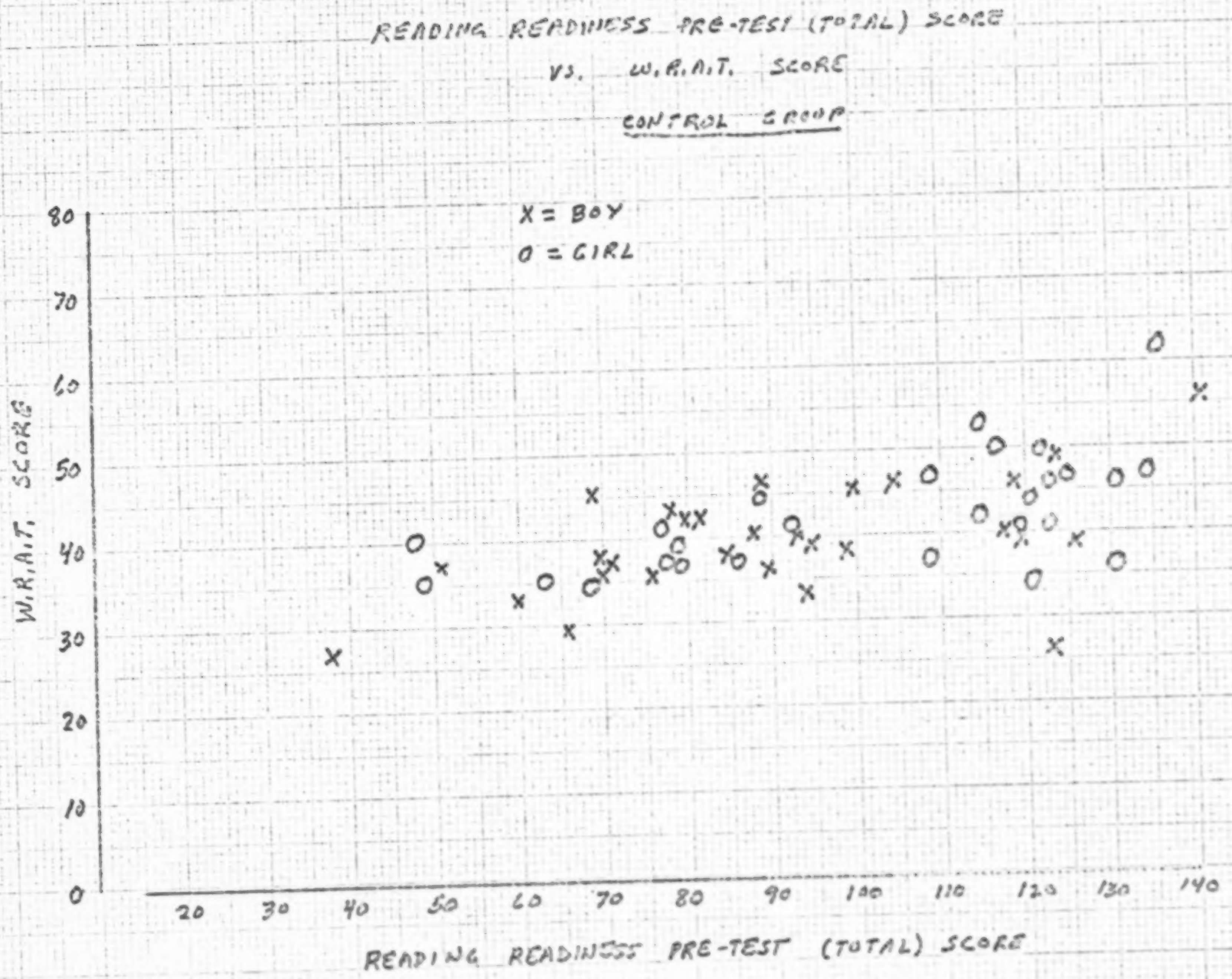
READING READINESS PRE-TEST (TOTAL) SCORE
VS. W.R.A.T. SCORE
CONTROL GROUP
X = BOY
O = GIRL
W.R.A.T. SCORE
80
70
60
50
40
30
20
10
0
20
30
40
50
60
70
80
90
100
110
120
130
140
READING READINESS PRE-TEST (TOTAL) SCORE

Figure 3

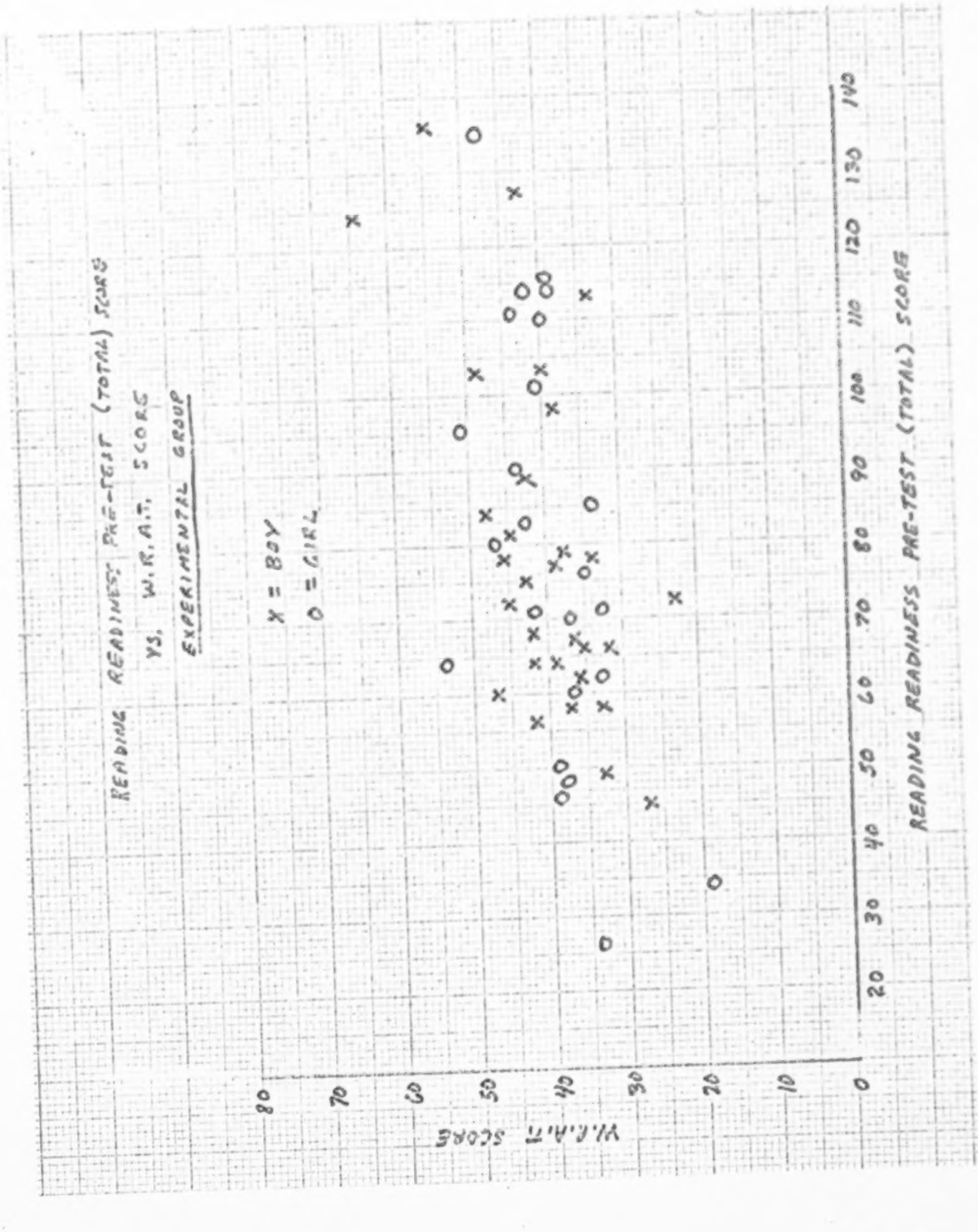
READING READINESS PRE-TEST (TOTAL) SCORE
VS. W.R.A.T. SCORE
EXPERIMENTAL GROUP
X = BOY
O = GIRL
W.R.A.T. SCORE
0
10
20
30
40
50
60
70
80
20
30
40
50
60
70
80
90
100
110
120
130
140
READING READINESS PRE-TEST (TOTAL) SCORE

Figure 4

and 4) and quadratic relationships for the experimental group (Figures 1 and 3).

To summarize, the following relationships were found to hold between pairs of test scores:

Pre-test versus Post-test I:

Control Group: The relationship is linear.
Experimental Group: The relationship is quadratic.

Pre-test versus Post-test II:

Control Group: The relationship is linear.
Experimental Group: The relationship is quadratic.

Post-test I versus Post-test II:

Control Group: The relationship is linear.
Experimental Group: The relationship is linear.

Pre-test versus M.A.T. (less Arithmetic):

Control Group: The relationship is linear.
Experimental Group: The relationship is linear.

Pre-test versus W.R.A.T.:

Control Group: The relationship is linear.
Experimental Group: The relationship is linear.

The regression equations presented in the next section (Section 4) are mathematical representations of the linear relationships of pre-test subtest scores to the reading achievement (M.A.T. and W.R.A.T.) criteria.

Although further investigation of the precise form of the quadratic relationships listed above (pre-test versus post-test scores) would be an interesting mathematical exercise, with a transformation of the form $u = x + y$ and $w = x - y$ facilitating construction of a quadratic regression function, it is obvious that the results of such an exercise would be of little, if any, clinical consequence. For example, knowing that training in letters and numbers would provide post-training scores on the Gates Letters and Numbers Subtest that were a quadratic function of the equivalent pre-training subtest scores may be of interest in itself. However, the precise form of that relationship could not conceivably be of interest in the absence of any lasting effects of such training.

4. PREDICTION OF READING TEST RESULTS

The specifications for this section of the statistical appendix are as follows:

> "4. The relationships discovered in Number 3 (above) would dictate the manner in which this part of the analysis would be done. Adjustments would be required if relationships are not linear. Transformations would be used when necessary to yield important educational data. This phase of the analysis would involve a series of step-wise regression analyses predicting to the two criterion measures.
>
> "Predictor variables will include: the five subscale scores on the Gates Reading Readiness Test, the score on the Draw-A-Man Test, and the child's Chronological Age (all measured in kindergarten). The following prediction equations would be obtained:
>
> "a. Predicting to end-of-first-grade reading on the group reading test for children who have been taught the alphabet and number names in kindergarten.
>
> "b. Predicting to end-of-first-grade reading on the group reading test for children who were not taught alphabet and number names in kindergarten.
>
> "c. Predicting to end-of-first-grade reading on the individually administered reading tests for children who have been taught alphabet and number names in kindergarten.
>
> "d. Predicting to end-of-first-grade reading on the individually administered reading tests for children who were not taught alphabet and number names in kindergarten.

> "These equations should be useful, not only in further assessing the impact of training in alphabet and numbers in kindergarten, but also in evaluating the relative merits of the two types of reading tests (group versus individual)."

Using pre-test reading readiness subtest scores, together with the Draw-A-Man Test score as independent variables and the M.A.T. reading (total less arithmetic) score and the W.R.A.T. score as dependent variables, the following regression equations were obtained:

Boys (N=58); Prediction Equations:

M.A.T. = .453 (L&N) + .942 (PD) + 38.7 (R = .54)

Boys (N=58); Prediction Equations:

W.R.A.T. = .194 (L&N) + .664 (Rhym) + 27.9 (R = .62)

Girls (N=51); Prediction Equations:

M.A.T. = 1.460 (PD) + .339 (L&N) + 36.6 (R = .68)

Girls (N=51); Prediction Equations:

W.R.A.T. = .105 (L&N) + .442 (DAM) + .565 (Rhym) + 24.7 (R = .65)

Key: L&N = Letters and Numbers subtest score
PD = Picture Directions subtest score
Rhym = Rhyming subtest score
DAM = Draw-A-Man Test score

The multiple correlation coefficients (the R's) listed above are of the same general order of magnitude (.62 to .68) except for the equation desired for the boys in predicting to the M.A.T. reading score (R = .54). This provides an additional clue to the reason for sex effects being present in the analyses of Section 1 of this appendix, as manifested by girls performing better than boys on the M.A.T. reading test. This matter is discussed in conjunction with Table 6-n.

5. ANALYSIS: LETTERS VERSUS NUMBERS

This section represents an extension of Section 4, with the letters portion and the numbers portion of the Letters and Numbers Subtest treated separately. The following are the specifications for this section:

> "5. The Gates Reading Readiness Test consists of five subtests. Subtest Number 5, Naming Letters and Numbers, will be examined intensively in this section of the research . The total possible score on this subtest is 62, one point gained for each recognition of the 26 capital letters, one point for correct recognition of the 26 lower case letters, and ten points for correct recognition for the numbers 0 through 9. The relationship between this subtest and end-of-first-grade reading has been demonstrated previously (Silberberg, Iversen, and Silberberg, 1968). However, the experience of the project consultants has led them to hypothesize that children who know the name of one number probably know the names of many numbers, a condition which does not appear to exist in the naming of alphabet letters. Therefore, it would be valuable to examine separately the relationships between the 52 letter names and the 10 number names with the criterion variables.
>
> "The analyses described in Number 4 would be repeated, except that each of the analyses would be done twice, once using the child's raw score on naming letters alone, and the other time using the child's raw score on naming numbers alone."

The regression procedures of Section 4 were repeated with one modification: The numbers portion was deleted from the Letters and Numbers Subtest score, thus providing a "letters subtest" score. All other subtest scores and the Draw-A-Man Test score remained the same. The following regression equations were obtained:

Boys (N=58); Prediction Equations:

M.A.T. - .492 (L) + .918 (Rhym) + 42.4   (R = .54)

Boys (N=59); Prediction Equations:

W.R.A.T. = .206 (L) + .666 (Rhym) + 29.2   (R = .61)

Girls (N=51); Prediction Equations:

M.A.T. = 1.54 (PD) + .352 (2) + 36.6   (R = .68)

Girls (N=51); Prediction Equations:

W.R.A.T. = .107 (L) + .454 (DAM) + .603 (Rhym) + 24.8
(R = .64)

Key: L = "Letters Subtest" score
All others as above

The regression procedures were again repeated, using only the "Numbers Subtest" portion of the Letters and Numbers Subtest score:

Boys (N-58); Prediction Equations:

M.A.T. = 1.47 (WM) + 1.57 (Rhym) + 42.7   (R = .47)

Boys (N=59); Prediction Equations:

W.R.A.T. = 1.00 (Rhym) + .812 (N) + 22.3   (R = .53)

Girls (N=51); Prediction Equations:

M.A.T. = 2.71 (N) + 1.13 (PD) + 34.8   (R = .67)

Girls (N=51); Prediction Equations:

W.R.A.T. = .777 (N) + .432 (DAM) + .497 (Rhym) + 22.6
(R = .64)

Key: N = "Numbers Subtest" score
WM = "Word Matching Subtest" score
All others as above

These two sets of regression equations are probably of but incidental interest. Only two items of interest stand out: (1) The minimal shrinkage of the multiple regression coefficients with the "Letters Subtest" score; and (2) the corresponding shrinkage, minimal for girls but marked for boys, with the "Numbers Subtest" score.

This suggests that there may be differences between boys and girls in their pre-test knowledge of letters that are unlike the corresponding differences in pre-test knowledge of numbers. Figures 5 and 6 on the pages following demonstrate that this is the case. Boys seem to have an edge in knowing numbers, but are far behind girls in knowing letters.

Forty-four of the fifty-nine boys (74.6%) knew at least eight numbers, as opposed to thirty-three of the fifty-one girls (64.7%).

Only twenty-two of the fifty-nine boys (37.3%) knew at least sixteen letters; but thirty of the fifty-one girls (58.8%) knew at least sixteen letters.

Since the range of chronological ages was restricted due to all children being in kindergarten at the time of testing, chronological age did not emerge as a predictor in any of the regression equations.

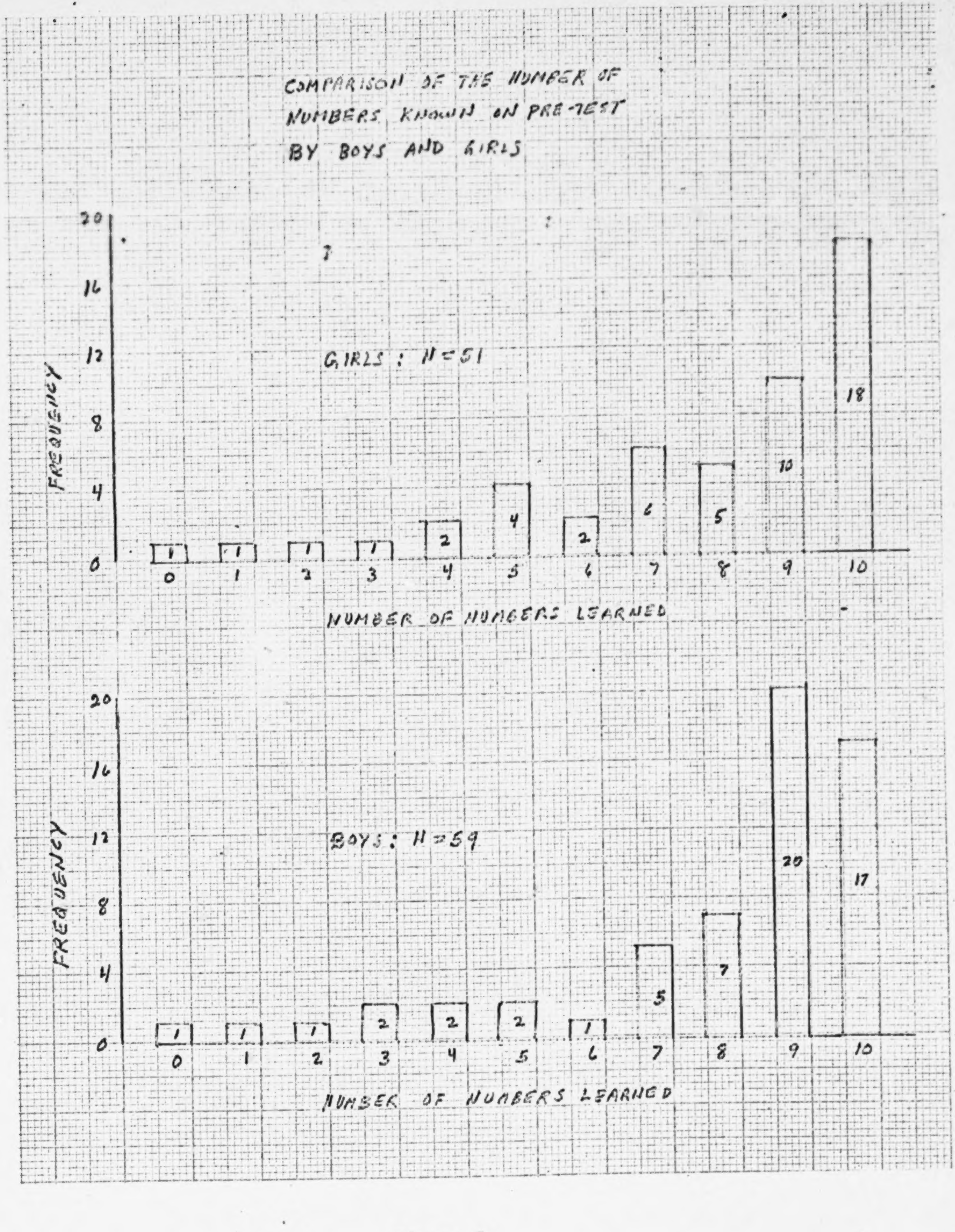
COMPARISON OF THE NUMBER OF NUMBERS KNOWN ON PRE-TEST BY BOYS AND GIRLS
GIRLS : N=51
FREQUENCY
0
4
8
12
16
20
1
1
1
1
2
4
2
6
5
10
18
0
1
2
3
4
5
6
7
8
9
10
NUMBER OF NUMBERS LEARNED
BOYS : N=59
FREQUENCY
0
4
8
12
16
20
1
1
1
2
2
2
1
5
7
20
17
0
1
2
3
4
5
6
7
8
9
10
NUMBER OF NUMBERS LEARNED

Figure 5

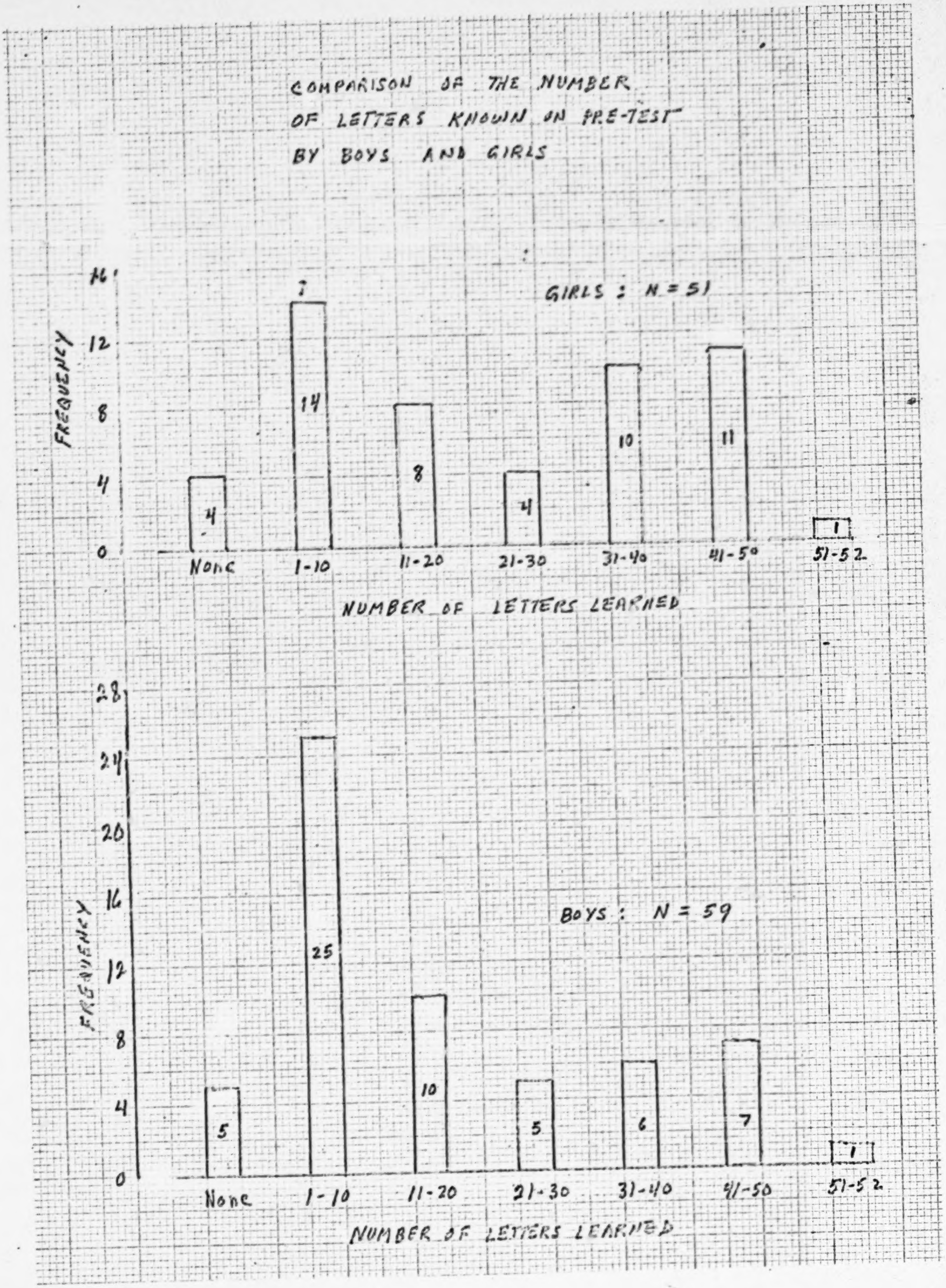
COMPARISON OF THE NUMBER
OF LETTERS KNOWN ON PRE-TEST
BY BOYS AND GIRLS
GIRLS : N = 51
FREQUENCY
16
12
8
4
0
4
14
8
4
10
11
1
None
1-10
11-20
21-30
31-40
41-50
51-52
NUMBER OF LETTERS LEARNED
BOYS : N = 59
FREQUENCY
28
24
20
16
12
8
4
0
5
25
10
5
6
7
1
None
1-10
11-20
21-30
31-40
41-50
51-52
NUMBER OF LETTERS LEARNED

Figure 6

6. ADDITIONAL FINDINGS

The four subtests of the M.A.T. were examined separately in this section. Tables 6-a through 6-d represent analyses of variance of subtest scores, with a grouping of children according to total reading readiness scores.

Tables 6-e through 6-h represent equivalent analyses, but with grouping on the basis of the four reading readiness subtests excluding the Letters and Numbers Subtests.

Tables 6-i through 6-l again represent equivalent analyses, but with grouping on the basis of the Letters and Numbers Subtest alone.

The previously observed sex effects (in Section 1 where the analyses concerned the total M.A.T. score but without the arithmetic subtest) are evident in only one of the M.A.T. subtest analyses -- reading. Tables 6-c, 6-g, and 6-k all show significant sex effects; none of the other tables do.

TABLE 6-a

Metropolitan Achievement Test
Word Knowledge Subtest

Reading Readiness Pre-Test Score (All Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-71)	$\bar{x}=24.5$	$\bar{x}=25.4$	$\bar{x}=24.2$	$\bar{x}=23.2$
Middle (72-99)	$\bar{x}=24.2$	$\bar{x}=29.0$	$\bar{x}=29.5$	$\bar{x}=30.0$
High (100 +)	$\bar{x}=31.2$	$\bar{x}=30.4$	$\bar{x}=30.7$	$\bar{x}=33.0$

	Difference	S.E.	P
Sex Effect	1.10-	1.01	---
Group Effect	1.01-	1.01	---
Level Effect	6.97-	1.26	.01
Sex/Group Interaction	.52-	1.01	---
Sex/Level Interaction	.43	1.26	---
Group/Level Interaction	1.13	1.26	---

TABLE 6-b

Metropolitan Achievement Test
Word Discrimination Subtest

Reading Readiness Pre-Test Score (All Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-71)	$\bar{x}=21.7$	$\bar{x}=24.8$	$\bar{x}=23.6$	$\bar{x}=21.7$
Middle (72-99)	$\bar{x}=25.4$	$\bar{x}=27.8$	$\bar{x}=29.3$	$\bar{x}=29.1$
High (100 +)	$\bar{x}=30.3$	$\bar{x}=31.0$	$\bar{x}=27.4$	$\bar{x}=31.0$

	Difference	S.E.	P
Sex Effect	1.28-	1.03	---
Group Effect	.18-	1.03	---
Level Effect	6.97-	1.28	.01
Sex/Group Interaction	.76-	1.03	---
Sex/Level Interaction	.75	1.28	---
Group/Level Interaction	.44-	1.28	---

TABLE 6-c

Metropolitan Achievement Test
Reading Subtest

Reading Readiness Pre-Test Score (All Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-71)	$\bar{x}=19.4$	$\bar{x}=23.7$	$\bar{x}=16.4$	$\bar{x}=18.2$
Middle (72-99)	$\bar{x}=24.7$	$\bar{x}=31.8$	$\bar{x}=22.9$	$\bar{x}=30.6$
High (100 +)	$\bar{x}=30.8$	$\bar{x}=29.7$	$\bar{x}=26.0$	$\bar{x}=33.2$

	Difference	S.E.	P
Sex Effect	4.48-	1.75	.05
Group Effect	2.14	1.75	---
Level Effect	10.50-	2.19	.01
Sex/Group Interaction	1.05	1.75	---
Sex/Level Interaction	.04-	2.19	---
Group/Level Interaction	1.78	2.19	---

TABLE 6-d

Metropolitan Achievement Test
Arithmetic Subtest

Reading Readiness Pre-Test Score (All Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-71)	$\bar{x}=41.8$	$\bar{x}=45.4$	$\bar{x}=45.1$	$\bar{x}=45.0$
Middle (72-99)	$\bar{x}=49.4$	$\bar{x}=50.5$	$\bar{x}=50.4$	$\bar{x}=51.1$
High (100 +)	$\bar{x}=58.3$	$\bar{x}=55.6$	$\bar{x}=48.3$	$\bar{x}=52.0$

	Difference	S.E.	P
Sex Effect	1.03-	1.85	---
Group Effect	1.50	1.85	---
Level Effect	9.21-	2.31	.01
Sex/Group Interaction	.40	1.85	---
Sex/Level Interaction	.61-	2.31	---
Group/Level Interaction	4.13-	2.31	---

TABLE 6-e

Metropolitan Achievement Test
Word Knowledge Subtest

Reading Readiness Pre-Test Score (Four Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-55)	$\bar{x}=23.6$	$\bar{x}=25.6$	$\bar{x}=26.6$	$\bar{x}=24.7$
Middle (56-66)	$\bar{x}=27.3$	$\bar{x}=27.4$	$\bar{x}=28.5$	$\bar{x}=31.5$
High (67 +)	$\bar{x}=28.0$	$\bar{x}=32.0$	$\bar{x}=29.7$	$\bar{x}=32.9$

	Difference	P
Sex Effect	1.73-	---
Exp. Effect	1.64-	---
Level Effect	5.55-	.01
Sex/Exp. Interaction	.30-	---
Sex/Level Interaction	1.76	---
Exp./Level Interaction	.15	---

TABLE 6-f

Metropolitan Achievement Test
Word Discrimination Subtest

Reading Readiness Pre-Test Score (Four Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-55)	$\bar{x}=21.7$	$\bar{x}=24.7$	$\bar{x}=25.3$	$\bar{x}=25.2$
Middle (56-66)	$\bar{x}=25.9$	$\bar{x}=28.4$	$\bar{x}=27.8$	$\bar{x}=31.3$
High (67 +)	$\bar{x}=29.6$	$\bar{x}=31.0$	$\bar{x}=28.0$	$\bar{x}=29.9$

	Difference	P
Sex Effect	2.03-	---
Exp. Effect	1.01-	---
Level Effect	5.39-	.01
Sex/Exp. Interaction	.28-	---
Sex/Level Interaction	.10	---
Exp./Level Interaction	1.68-	---

TABLE 6-g

Metropolitan Achievement Test
Reading Subtest

Reading Readiness Pre-Test Score (Four Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-55)	$\bar{x}=19.2$	$\bar{x}=26.1$	$\bar{x}=18.1$	$\bar{x}=21.8$
Middle (56-66)	$\bar{x}=26.4$	$\bar{x}=24.3$	$\bar{x}=24.6$	$\bar{x}=33.2$
High (67 +)	$\bar{x}=28.8$	$\bar{x}=33.8$	$\bar{x}=20.0$	$\bar{x}=32.5$

	Difference	P
Sex Effect	5.72-	.01
Exp. Effect	1.40	---
Level Effect	7.48-	.01
Sex/Exp. Interaction	2.50	---
Sex/Level Interaction	1.73	---
Exp./Level Interaction	1.20-	---

TABLE 6-h

Metropolitan Achievement Test
Arithmetic Subtest

Reading Readiness Pre-Test Score (Four Subtests)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-55)	$\bar{x}=42.7$	$\bar{x}=45.8$	$\bar{x}=48.0$	$\bar{x}=47.0$
Middle (56-66)	$\bar{x}=52.5$	$\bar{x}=51.7$	$\bar{x}=50.1$	$\bar{x}=49.8$
High (67 +)	$\bar{x}=52.3$	$\bar{x}=54.2$	$\bar{x}=45.3$	$\bar{x}=52.6$

	Difference	P
Sex Effect	1.69-	---
Exp. Effect	1.06	---
Level Effect	5.20-	.05
Sex-Exp. Interaction	.32	---
Sex-Level Interaction	1.77	---
Exp.-Level Interaction	3.76-	---

TABLE 6-i

Metropolitan Achievement Test
Word Knowledge Subtest

Reading Readiness Pre-Test Score (Letters & Numbers)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-14)	$\bar{x}$=24.2	$\bar{x}$=25.6	$\bar{x}$=25.0	$\bar{x}$=24.7
Middle (15-34)	$\bar{x}$=24.6	$\bar{x}$=28.2	$\bar{x}$=28.6	$\bar{x}$=29.1
High (35 +)	$\bar{x}$=31.2	$\bar{x}$=30.7	$\bar{x}$=30.7	$\bar{x}$=33.0

	Difference	P
Sex Effect	1.17-	---
Exp. Effect	1.12-	---
Level Effect	6.50-	.01
Sex-Exp. Effect	.33-	---
Sex-Level Effect	.15	---
Exp.-Level Effect	.49	---

TABLE 6-j

Metropolitan Achievement Test
Word Discrimination Subtest

Reading Readiness Pre-Test Score (Letters & Numbers)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-14)	$\bar{x}$=22.3	$\bar{x}$=24.9	$\bar{x}$=26.6	$\bar{x}$=25.7
Middle (15-34)	$\bar{x}$=24.9	$\bar{x}$=27.9	$\bar{x}$=26.9	$\bar{x}$=26.8
High (35 +)	$\bar{x}$=30.3	$\bar{x}$=30.8	$\bar{x}$=28.2	$\bar{x}$=31.0

	Difference	P
Sex Effect	1.30-	---
Exp. Effect	.69-	---
Level Effect	5.21-	.01
Sex-Exp. Interaction	.69-	---
Sex-Level Interaction	.38	---
Exp.-Level Interaction	1.74-	---

TABLE 6-k

Metropolitan Achievement Test
Reading Subtest

Reading Readiness Pre-Test Score (Letters & Numbers)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-14)	$\bar{x}=21.1$	$\bar{x}=23.1$	$\bar{x}=20.7$	$\bar{x}=24.5$
Middle (15-34)	$\bar{x}=22.8$	$\bar{x}=30.6$	$\bar{x}=20.2$	$\bar{x}=27.0$
High (35 +)	$\bar{x}=30.8$	$\bar{x}=30.7$	$\bar{x}=25.4$	$\bar{x}=33.2$

	Difference	P
Sex Effect	4.64-	.05
Exp. Effect	1.35	---
Level Effect	7.64-	.01
Sex-Exp. Interaction	1.45	---
Sex-Level Interaction	.47	---
Exp.-Level Interaction	.97-	---

TABLE 6-1

Metropolitan Achievement Test
Arithmetic Subtest

Reading Readiness Pre-Test Score (Letters & Numbers)	Exp. Boys	Exp. Girls	Cont. Boys	Cont. Girls
Low (0-14)	$\bar{x}=41.3$	$\bar{x}=45.0$	$\bar{x}=48.1$	$\bar{x}=48.5$
Middle (15-34)	$\bar{x}=50.9$	$\bar{x}=49.5$	$\bar{x}=48.5$	$\bar{x}=49.1$
High (35 +)	$\bar{x}=58.3$	$\bar{x}=57.5$	$\bar{x}=48.2$	$\bar{x}=52.0$

	Difference	P
Sex Effect	1.03-	---
Exp. Effect	1.31	---
Level Effect	8.29-	.01
Sex-Exp. Interaction	.53	---
Sex-Level Interaction	.29-	---
Exp.-Level Interaction	6.48	.05

Correlations between reading readiness and reading achievement measures are presented in Table 6-m.

TABLE 6-m

Correlation Coefficients Between Reading Readiness and Reading Achievement Measures

READING READINESS MEASURES	BOYS		GIRLS	
	M.A.T.*	W.R.A.T.	M.A.T.*	W.R.A.T.
Age	-.03	-.19	.06	.17
Draw-A-Man Score	.22	.21	.32	.46
Pre-Test (Total Score)	.54	.59	.62	.56
Picture Directions	.31	.16	.60	.39
Word Matching	.40	.33	.37	.42
Word-Card Matching	.22	.29	.26	.22
Rhyming	.33	.45	.51	.47
Letters and Numbers	.48	.57	.54	.51
Post-test I (Total Score)	.57	.62	.63	.54
Post-test II (Total Score)	.57	.61	.66	.63
Pre-test (Letters only)	.48	.56	.50	.48
Pre-test (Numbers only)	.25	.35	.61	.54
W.R.A.T.	.73	---	.69	---

*M.A.T. (Total less arithmetic) score

One final analysis of variance was performed. This was done to shed some light on the significant sex effects found in the analyses of the M.A.T. reading subtest scores. Since this subtest contains contextual cues, it may be that the girls in this study may have had higher IQ levels than the boys. The results are displayed in Table 6-n.

TABLE 6-n

Draw-A-Man Test Scores

	Experimental	Control	Total
Boys	N=30 $\bar{x}$=14.67	N=29 $\bar{x}$=14.69	N=59 $\bar{x}$=14.68
Girls	N=24 $\bar{x}$=15.67	N=27 $\bar{x}$=17.33	N=51 $\bar{x}$=16.55
Total	N=54 $\bar{x}$=15.11	N=56 $\bar{x}$=15.96	N=110 $\bar{x}$=15.55

Source of Variation	d.f.	S.S.	M.S.	F	P
Groups	3	131	43.7	2.52	.06
Sex	1	96	96	5.54	.02
Group	1	20	20	1.15	---
Sex x group	1	15	15	.87	---
Error	106	1838	17.34		
Total	109	1969			

Table 6-n shows that the girls did have significantly higher IQ's (as measured by the Draw-A-Man Test) than did the boys. This probably is the factor accounting for the sex differences and is a reflection of the better use and comprehension of contextual cues by the more academically apt girls.

SUPPLEMENT A

Data Listings

KEY FOR DATA LISTS

C.A. = Chronological Age (in months)

D.A.M. = Draw-A-Man

GATES READING READINESS TEST

PRE.I = Pre-Test I
POST.I = Post-Test I
POST.II = Post-Test II

1 = Picture Direction
2 = Word Matching
3 = Word-Card Matching
4 = Rhyming
5 = Reading Letters and Numbers
T = Total Score

Pre.I Alphabet = Pre-Test Alphabet Only
Pre.I Numbers = Pre-Test Numbers Only
Alphab. Hi-Lo = Alphabet High-Low
Numbers Hi-Lo = Numbers High-Low

METROPOLITAN ACHIEVEMENT TEST

1 = Word Knowledge
2 = Word Discrimination
3 = Reading
4 = Arithmetic
T = Total Score (Less Arithmetic)

W.R.A.T. = WIDE RANGE ACHIEVEMENT TEST

EXPERIMENTAL BOYS

			GATES PRE. I						GATES POST. I						GATES POST. II											MET. ACH. TEST					
I.D.Number	C.A.	D.A.M.	1	2	3	4	5	T	1	2	3	4	5	T	1	2	3	4	5	T	Pre.I Alphabet	Pre.I Numbers	Alphab. Hi-Lo	Numbers Hi-Lo	Sex	1	2	3	4	T	WRAT
101	67	12	33	16	16	13	58	136	34	18	20	13	61	146	33	18	17	13	62	143	49	09	1	1	1	34	35	44	56	113	55
102	68	15	32	17	13	09	56	127	32	15	15	13	62	137	36	17	17	12	60	142	46	10	1	1	1	33	31	30	59	094	43
103	63	16	26	15	11	13	59	124	30	14	20	12	62	138	31	17	19	11	62	140	49	10	1	1	1	34	32	42	59	108	65
104	68	12	31	15	11	13	43	113	33	16	06	10	50	115	31	13	06	14	48	112	33	10	1	1	1	20	23	17	58	060	34
105	71	14	20	16	14	12	41	103	35	15	07	13	46	116	32	18	12	10	42	114	31	10	1	1	1	33	28	23	60	084	40
106	66	20	26	15	14	13	35	103	31	15	15	14	51	126	32	15	08	14	47	116	27	08	1	1	1	33	33	29	58	095	49
107	74	18	31	10	11	12	34	098	30	06	05	14	42	097	32	17	10	13	42	114	25	09	1	1	1	17	22	14	54	053	39
108	69	17	31	08	08	13	29	089	24	12	10	12	45	103	29	15	09	12	41	106	20	09	1	1	1	28	27	40	56	095	43
109	73	12	31	12	11	14	16	084	33	06	12	14	26	091	35	14	08	14	24	095	07	09	2	1	1	30	32	32	60	094	48
110	74	12	30	16	09	12	14	081	31	14	09	12	28	094	32	15	16	14	28	105	04	10	2	2	1	28	31	31	32	090	45
111	65	14	27	08	16	12	16	079	33	13	14	12	54	126	29	13	07	10	43	102	06	10	2	2	1	21	24	18	48	063	37
112	76	14	31	07	07	10	23	078	31	08	10	12	45	106	28	13	14	11	37	103	14	09	1	2	1	27	32	29	53	088	46
113	74	13	32	16	10	11	09	078	29	15	12	10	22	088	29	16	11	13	10	079	02	07	2	2	1	18	22	19	43	059	34
114	71	16	25	13	10	14	15	077	32	15	07	14	31	099	31	15	08	12	27	093	10	05	2	2	1	30	27	18	45	075	39
115	70	14	25	14	12	14	10	075	32	18	14	12	36	112	31	18	12	14	34	109	02	08	2	2	1	26	26	34	57	086	43
116	72	19	25	14	09	07	17	072	19	14	10	07	18	068	22	17	16	12	18	085	07	10	2	2	1	10	10	21	52	041	23
117	73	29	19	09	08	11	25	072	30	17	10	12	52	121	22	15	01	06	32	076	15	10	1	2	1	31	27	16	43	074	45
119	72	13	25	14	12	07	10	068	32	15	11	12	37	107	31	15	10	08	24	088	00	10	2	2	1	31	26	18	50	075	42
120	67	11	24	15	08	05	15	067	29	13	11	08	23	084	29	10	08	10	26	083	06	09	2	2	1	22	25	22	58	069	36
121	77	09	27	08	09	11	11	066	32	01	11	13	28	085	28	04	07	10	21	070	04	07	2	2	1	14	15	09	17	038	35
122	73	12	29	03	10	10	14	066	34	08	09	08	35	094	26	07	06	13	28	080	09	05	2	2	1	25	28	28	52	081	32
123	66	13	19	02	10	13	20	064	29	05	05	14	40	093	32	09	06	12	43	102	11	09	2	2	1	30	23	18	40	071	42
124	75	10	22	13	11	06	12	064	33	10	06	10	34	093	32	08	10	12	41	103	06	06	2	2	1	27	30	27	54	084	39
125	65	15	32	04	11	11	04	062	29	06	06	08	17	066	29	12	00	12	16	069	04	04	2	2	1	26	21	31	44	078	36
126	64	16	24	01	10	14	11	060	29	07	00	08	18	062	29	12	11	13	15	080	04	07	2	2	1	29	24	07	33	060	47
127	68	17	31	04	07	07	09	058	30	08	11	09	15	073	34	13	17	11	21	096	01	08	2	2	1	16	22	20	50	058	33
128	72	11	28	06	10	05	09	058	28	12	08	12	13	073	31	10	07	14	15	077	01	08	2	2	1	22	17	16	40	055	37
129	71	18	33	04	04	12	03	056	30	08	04	14	28	084	27	07	05	13	40	092	02	01	2	2	1	31	26	17	30	074	42
133	73	12	21	06	07	07	08	049	22	07	08	02	16	055	29	10	06	12	16	073	00	08	2	2	1	26	14	21	54	061	33
134	72	16	17	08	09	07	04	045	28	08	06	09	09	060	25	12	14	12	09	072	00	04	2	2	1	20	11	18	22	049	27

EXPERIMENTAL GIRLS

I.D.Number	C.A.	D.A.M.	GATES PRE. I						GATES POST. I						GATES POST. II						Pre.I Alphabet	Pre.I Numbers	Alphab. Hi-Lo	Numbers Hi-Lo	Sex	MET. ACH. TEST					WRAT
			1	2	3	4	5	T	1	2	3	4	5	T	1	2	3	4	5	T						1	2	3	4	T	
265	64	15	32	17	20	14	52	135	34	18	18	14	59	143	36	17	11	14	57	135	42	10	1	1	2	35	32	42	63	109	48
266	73	14	30	15	18	10	41	114	32	13	19	14	56	134	35	15	13	13	45	121	32	09	1	1	2	32	32	34	59	098	42
267	64	23	18	13	12	13	58	114	30	16	06	12	61	125	31	16	08	09	58	122	48	10	1	1	2	27	30	20	61	077	39
268	74	12	28	16	20	14	36	114	33	16	14	14	48	125	30	18	13	13	52	126	26	10	1	1	2	29	27	22	52	078	39
270	71	16	31	17	18	14	31	111	36	17	17	14	46	130	34	18	17	14	49	132	21	10	1	1	2	29	32	28	49	089	44
271	78	14	35	17	14	10	34	110	35	18	12	13	57	135	33	15	13	12	55	128	24	10	1	1	2	32	32	38	50	102	40
272	67	16	29	11	08	09	44	101	33	04	08	10	48	103	28	15	13	07	44	107	34	10	1	1	2	29	32	24	55	085	41
273	65	10	22	11	05	10	47	095	30	13	06	14	54	117	27	14	08	14	55	118	39	08	1	1	2	32	32	42	55	106	51
274	76	31	31	16	12	13	18	090	33	15	14	10	18	090	34	16	12	13	17	092	11	07	2	1	2	35	31	39	52	105	44
275	73	15	29	08	11	07	29	084	34	13	14	13	43	117	34	17	14	13	41	119	20	09	1	1	2	27	18	28	60	073	35
276	70	15	31	13	12	03	24	083	30	10	15	09	34	098	35	16	14	09	35	109	18	06	1	1	2	30	29	36	54	095	43
277	72	15	27	14	10	13	16	080	33	18	13	12	34	110	34	17	14	13	34	112	07	09	2	2	2	29	31	29	50	089	47
279	68	08	25	02	08	11	30	076	24	07	04	09	37	081	28	08	08	07	44	095	25	05	1	2	2	21	26	17	32	064	35
280	65	21	28	08	11	13	11	071	34	07	04	13	36	094	31	12	08	12	40	103	04	07	2	2	2	26	24	19	44	069	42
281	68	17	27	10	08	06	20	071	33	11	14	13	32	103	29	16	12	12	31	094	17	03	2	2	2	23	24	30	49	077	33
282	67	15	25	16	13	05	11	070	31	17	12	09	31	100	35	14	14	08	47	118	03	08	2	2	2	29	31	24	44	084	37
283	67	23	27	04	10	13	10	064	27	12	01	09	18	067	31	14	12	14	32	103	03	07	2	2	2	32	34	32	53	098	54
284	72	09	26	08	12	10	06	062	27	09	03	09	11	059	27	14	13	10	14	078	04	02	2	2	2	22	22	18	54	062	33
285	63	15	26	04	08	10	12	060	26	15	14	13	22	100	32	14	10	13	20	089	03	09	2	2	2	25	19	29	45	073	37
286	64	20	14	05	08	09	14	050	23	05	03	06	51	088	30	13	02	12	44	101	08	06	2	2	2	28	29	31	42	088	39
287	68	18	25	09	04	05	05	048	29	08	02	07	10	056	26	14	09	12	10	071	00	05	2	2	2	26	25	23	57	074	37
288	66	13	21	01	01	12	11	046	24	10	11	10	36	091	29	12	09	11	36	097	06	05	2	2	2	32	30	31	54	093	39
289	64	12	13	07	07	04	03	034	25	06	06	01	02	040	25	11	06	06	10	058	02	01	2	2	2	13	11	07	19	031	19
290	70	09	09	04	09	04	00	026	21	05	13	01	23	063	27	05	13	04	22	071	00	00	2	2	2	23	24	17	38	064	34

CONTROL GIRLS

I.D.Number	C.A.	D.A.M.	GATES PRE. I						GATES POST. I						GATES POST. II						Pre.I Alphabet	Pre.I Numbers	Alphab. Hi-Lo	Numbers Hi-Lo	Sex	MET. ACH. TEST					WRAT
			1	2	3	4	5	T	1	2	3	4	5	T	1	2	3	4	5	T						1	2	3	4	T	
493	71	26	29	18	17	13	58	135	28	18	19	14	61	140	33	18	18	14	62	145	49	09	1	1	2	35	34	42	56	111	62
495	74	23	28	17	17	12	60	134	30	18	17	14	60	139	34	17	11	14	60	136	50	10	1	1	2	34	29	26	49	089	47
496	75	16	31	14	17	14	54	130	32	17	14	14	49	126	35	16	11	14	51	127	45	09	1	1	2	32	28	20	41	080	36
497	64	16	34	14	13	14	55	130	35	15	14	14	58	136	35	11	10	14	58	128	45	10	1	1	2	35	35	43	61	113	46
498	75	12	32	10	18	14	50	124	31	10	11	13	56	121	29	16	13	14	52	124	40	10	1	1	2	34	33	24	57	091	47
499	75	22	24	15	13	13	57	122	28	15	16	13	56	128	25	18	14	14	48	119	47	10	1	1	2	30	32	23	42	085	41
400	72	20	35	14	11	11	51	122	34	17	18	14	58	141	35	17	16	14	59	141	41	10	1	1	2	35	31	46	59	112	46
401	74	19	34	13	16	14	44	121	31	17	11	14	44	117	29	18	08	14	59	128	34	10	1	1	2	34	33	42	53	109	50
402	67	23	24	13	16	06	61	120	27	13	19	14	61	134	30	15	12	12	59	128	51	10	1	1	2	31	32	34	50	097	44
403	63	14	32	15	18	14	41	120	32	17	12	14	43	118	32	17	10	12	42	113	31	10	1	1	2	35	25	27	52	087	34
404	74	14	33	17	12	13	43	118	36	17	13	13	47	126	33	18	12	14	47	124	35	08	1	1	2	33	25	28	54	086	40
405	74	21	31	12	08	14	51	116	33	11	15	14	49	122	33	16	09	14	49	121	41	10	1	1	2	35	33	40	44	108	50
406	64	22	32	11	12	14	45	114	28	14	13	12	43	110	28	13	10	14	35	100	35	10	1	1	2	34	34	37	60	105	42
407	69	16	33	16	04	14	47	114	36	17	16	14	47	130	34	18	14	14	49	129	37	10	1	1	2	33	31	41	51	105	53
408	65	16	23	16	14	11	44	108	24	16	06	13	45	104	29	17	09	12	46	113	35	09	1	1	2	28	29	21	44	078	47
409	64	19	28	02	16	12	50	108	31	04	16	14	58	123	31	17	12	14	52	126	42	08	1	1	2	30	32	37	59	099	37
411	72	17	34	06	16	13	23	092	33	10	11	13	31	098	36	16	00	13	31	096	13	10	1	1	2	32	30	34	57	096	41
412	73	24	29	18	15	07	19	088	29	17	16	14	24	100	33	16	16	13	28	106	12	07	2	1	2	28	18	29	35	075	45
413	71	22	29	12	16	12	16	085	29	16	08	14	18	085	32	16	09	14	22	093	07	09	2	1	2	32	31	23	57	086	38
414	74	12	29	14	08	14	13	078	32	15	09	11	21	088	32	10	17	13	22	094	04	09	2	2	2	35	30	44	60	109	39
415	67	10	32	14	14	12	05	077	32	16	11	13	08	080	31	16	16	14	09	086	00	05	2	2	2	28	31	26	47	085	37
416	72	12	31	04	11	06	25	077	32	10	03	07	22	074	29	10	09	12	22	082	16	09	1	2	2	21	30	22	51	073	37
417	64	16	27	12	02	08	27	076	33	14	14	14	33	108	34	16	10	14	47	121	20	07	1	2	2	34	34	36	51	104	41
418	63	12	25	09	09	08	17	068	25	06	15	12	17	075	32	08	02	11	14	067	10	07	2	2	2	33	31	29	44	093	35
419	76	16	25	08	07	06	16	062	30	06	10	14	46	106	26	10	07	14	35	092	08	08	2	2	2	24	14	16	49	054	35
420	65	11	24	09	01	10	04	048	21	02	07	06	12	048	26	01	11	09	18	065	00	04	2	2	2	27	20	16	43	063	35
421	70	17	15	11	06	07	08	047	27	09	04	12	11	063	23	16	04	07	13	063	04	04	2	2	2	09	22	12	44	043	40

CONTROL BOYS

			GATES PRE. I						GATES POST. I						GATES POST. II											MET. ACH. TEST					
I.D.Number	C.A.	D.A.M.	1	2	3	4	5	T	1	2	3	4	5	T	1	2	3	4	5	T	Pre.I Alphabet	Pre.I Numbers	Alphab. Hi-Lo	Numbers Hi-Lo	Sex	1	2	3	4	T	WRAT
336	74	14	32	17	17	13	61	140	31	16	12	13	58	130	34	17	14	14	56	135	51	10	1	1	1	31	35	37	52	103	56
337	70	15	30	15	14	13	53	125	31	15	05	13	55	119	28	17	10	12	57	124	44	09	1	1	1	22	24	15	53	061	39
338	74	22	33	12	09	12	57	123	33	14	00	12	55	114	33	15	16	14	61	139	47	10	1	1	1	35	35	45	60	115	49
339	70	19	35	13	10	14	50	122	32	12	12	13	52	121	35	16	10	13	52	126	40	10	1	1	1						26
340	63	13	32	13	16	14	44	119	34	13	15	14	47	123	33	14	11	09	44	111	35	09	1	1	1	32	19	09	31	060	39
341	64	11	31	13	09	13	52	118	31	15	12	14	55	127	31	17	12	12	57	129	42	10	1	1	1	32	29	36	59	097	46
342	73	16	24	09	11	13	60	117	30	07	08	13	50	108	31	13	15	13	51	123	50	10	1	1	1	28	24	18	41	070	40
343	69	21	31	12	08	13	40	104	36	14	11	14	46	121	31	17	04	13	44	109	31	09	1	1	1	35	26	22	42	083	46
344	75	16	15	10	11	14	49	099	32	13	10	14	57	126	29	14	01	11	49	104	40	09	1	1	1	31	34	21	48	086	45
345	71	16	28	14	11	14	31	098	30	15	11	13	35	104	29	15	12	14	42	112	23	08	1	1	1	30	23	17	42	070	38
346	69	15	29	16	04	14	31	094	29	15	07	10	31	092	25	16	04	11	23	079	22	09	1	1	1	30	29	23	42	082	39
347	79	11	25	09	14	12	33	093	31	13	10	08	39	101	29	13	05	11	41	099	24	09	1	1	1	20	25	17	54	062	33
348	71	12	32	11	18	13	18	092	30	15	08	14	23	090	33	14	15	12	29	103	09	09	2	1	1	31	30	18	46	079	40
349	75	11	34	07	08	14	26	089	36	15	11	14	31	107	35	14	02	14	26	091	16	10	1	1	1	29	29	18	61	076	36
350	72	15	34	11	09	14	20	088	35	10	10	14	21	090	30	15	09	13	19	086	11	09	2	1	1	29	31	11	39	071	46
351	68	17	29	10	11	14	23	087	30	07	09	04	26	076	30	16	12	00	22	080	13	10	1	1	1	30	30	18	47	078	40
352	71	15	31	11	10	07	21	080	32	15	09	08	20	084	34	17	09	12	18	090	12	09	2	2	1	29	29	36	61	094	42
353	73	18	30	14	12	13	11	080	31	13	13	13	16	086	30	14	12	14	13	083	04	07	2	2	1	33	34	33	54	100	42
354	69	17	26	11	08	07	27	079	36	15	12	08	26	097	31	15	10	08	22	086	20	07	1	2	1	32	34	33	56	099	42
355	71	18	28	12	09	12	22	084	34	17	08	14	28	101	33	16	07	12	18	086	13	09	2	1	1	29	23	30	57	082	38
356	74	12	34	12	08	09	12	075	33	06	16	14	16	085	35	15	13	13	13	089	03	09	2	2	1	31	30	23	48	084	35
357	68	15	24	08	06	14	18	070	31	06	08	14	18	077	30	09	09	13	17	078	09	09	2	2	1	32	27	22	45	081	37
358	69	13	25	09	10	10	15	069	33	10	10	09	21	083	31	12	09	11	16	079	06	09	2	2	1	28	24	10	58	062	37
359	67	15	26	10	10	09	14	069	33	09	14	13	23	092	28	11	12	13	22	086	06	08	2	2	1	25	24	19	59	068	36
360	64	12	27	10	07	13	11	068	33	08	04	08	05	058	26	03	08	08	06	051	08	03	2	2	1	25	31	16	51	072	45
361	74	15	35	06	06	12	06	065	30	07	09	13	08	067	35	14	05	12	10	076	03	03	2	2	1	25	26	25	40	076	29
362	67	10	29	13	05	12	00	059	26	14	00	12	03	055	28	15	04	10	04	061	00	00	2	2	1	21	23	17	38	061	33
363	70	09	18	05	02	08	17	050	26	01	02	11	20	060	21	08	09	13	13	064	07	10	2	2	1	23	16	10	23	049	37
364	65	13	21	03	08	03	02	037	30	00	01	09	03	043	28	05	00	03	02	038	00	02	2	2	1	15	18	12	47	045	27